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Dirt Track in the Sky

p. 98

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Warm Air Heating Systems
Steam Heating Systems
Cleaning, Adjusting Radiators
Noise in Steam System
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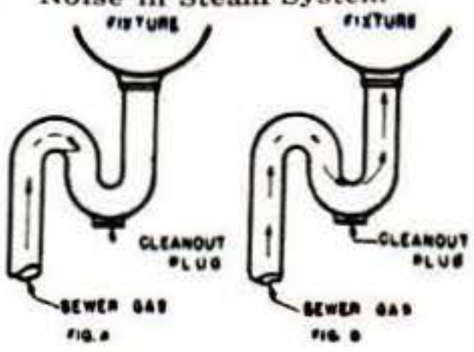

PLUMBING

Water Supply
Cause of Dirty Water
Repairing Sewage System
Cesspools, Septic Tanks
Stopped Up Sewer Pipes
Stopped Up Drains
Chemical Drain Cleaners
Plumbing Traps
Noisy Plumbing
Repairing Hot Water Tanks
Thawing Frozen Pipes
Water Softening Equipment
Repairing Faucets, Flush Tanks, Leaky Pipes, etc.

EXTERIOR REPAIRS

Waterproofing Damp Basements
Waterproofing Masonry Walls
Repairing Cracks in Foundation, Stucco Walls
Repairing Brick Walls
Repairing Leaky Roofs
Caulking Seams
Gutters and Downspouts
Ridding the House of Termites, etc.

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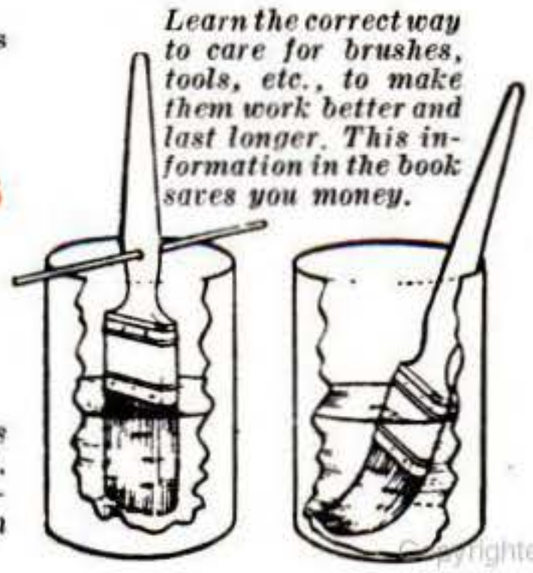
Building Garden Paths
Building Garden Pool
Care and Use of Garden Tools
Cold Frames
Rustic Screens and Arches
Building an Outdoor Fireplace
Erecting Garage, Summer Guest House or Play House in Garden, etc.

(Left) You SEE diagrams that help you locate and, with little effort, fix plumbing noises, leaks, and drain stoppages.

Learn the correct way to care for brushes, tools, etc., to make them work better and last longer. This information in the book saves you money.



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You can make these improvements yourself, at surprisingly little cost, with the help of *The Complete Home Handyman's Guide.*

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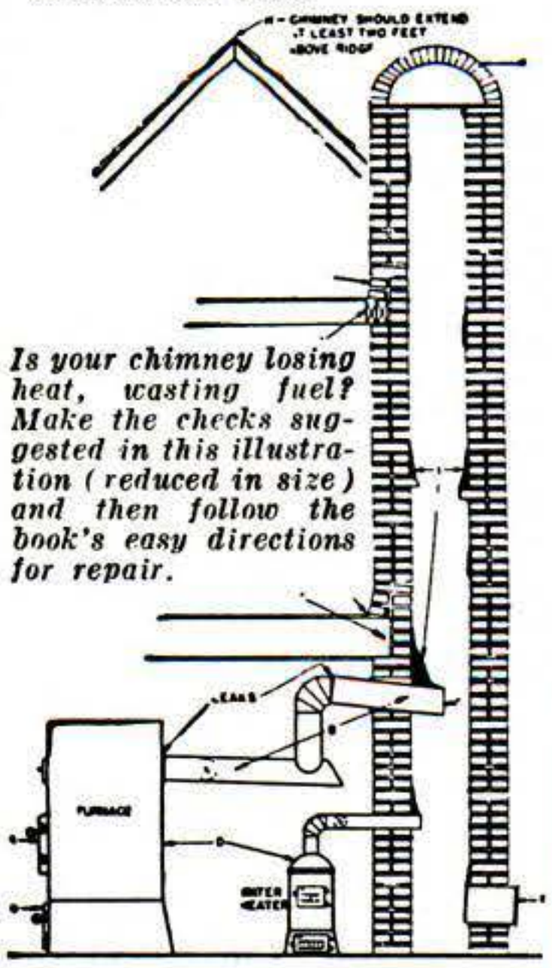
(Left) Furniture upholstery and repair is a fascinating and money-saving hobby when you follow the easy step-by-step instructions in this book.



Is your chimney losing heat, wasting fuel? Make the checks suggested in this illustration (reduced in size) and then follow the book's easy directions for repair.

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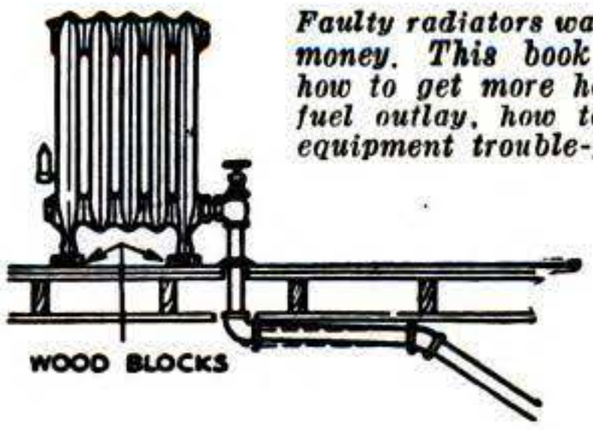
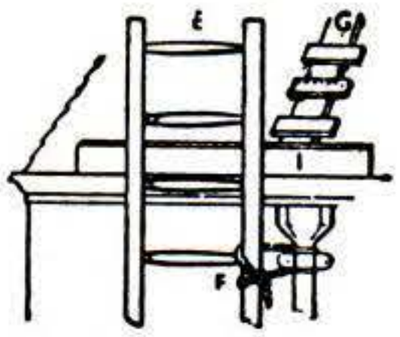
- Upholstery of Chairs, Sofas, etc.
- Replacing Worn Springs
- Strengthening Frame
- Furniture Upkeep, Cleaning, Removing Water Stains, Marks, Scratches, etc.
- Loose Joints
- Broken Chairs
- Polishes and Polishing
- Staining, etc.

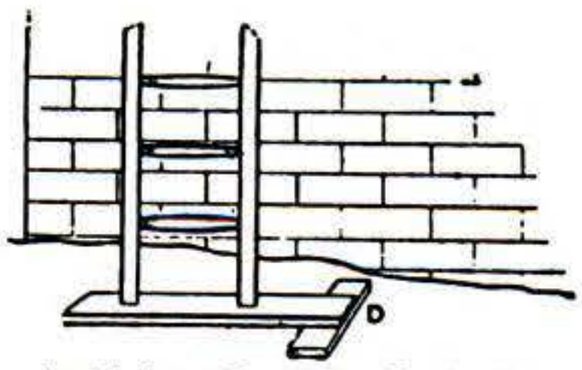
YOUR TOOL KIT

- Equipping Your Workshop
- Selecting the Right Tools
- Correct Use of Tools
- Care of Tools
- How to Sharpen Tools
- Sandpapers, Glues, etc.
- Soldering Equipment and Technique



Faulty radiators waste heat and money. This book shows you how to get more heat for your fuel outlay, how to keep your equipment trouble-free.





Avoid hazards. This illustration shows how to secure a ladder when you make roof repairs. Complete instructions for repairing walls, foundations, gutters, shingles, etc.

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CONTENTS FOR JANUARY, 1948

Cover painting by Phil Santry

Science News

60 Television Tubes an Hour.....108
Can Atom Guns Shoot Biggest Secrets?..113
Rocket's Flight Kept in Sight.....128
New Glass Defies Acid.....136
Wrapping 110,000 Volts in Gas.....137
Static from the Stars.....148
Crystal Tied in a Knot.....158

Science at Work

Picture of the Month..... 97
Glass Rods Can Land Big Fish.....110
Color Simplifies Chart.....111
How Igloos for Guns Are Built.....156
They Can Analyze Cinder in Your Eye..166

PSM Features

Chart Quizzes Students.....125
Tractor in Dual Role.....127
First Aid for Carpets.....134
A Five-Story Tin Can.....140
Half-Track Pulls Plow.....159
Tomorrow's Store Today.....160
How to Run a Power Shovel.....164
Motorcycle Cops Show How to Ride....169
Danger! 115 Volts.....186
Chemistry Predicts How Metals Act....232

Aviation

Dirt Track in the Sky..... 98
What's New in Aviation.....120
Fastest Thing on Wings?.....135
Twisting a Turbine's Tail.....142
Dialing Weather in the Sky.....145
Hitting the Hay Aloft.....163

Automobiles

Jap Cars Shown.....123
"Air Conditions" Cars.....126
Painless Tire Pumping.....133
Luxury for Sale: Price, Only $19,200....138
Tricycle Car Gets Around.....141
Twin Meter Parks Cars In Tandem.....144
Engine Is Where You Want It.....146
Gus Turns Prophet Without Profit.....172
Auto Hints.....176

Inventions

New Ideas from the Inventors.....106
Car Top Makes Cozy Bedroom.....124
Engine Without Valves.....155
Realism Fools Fish.....162

Photography

Keeping Films Frigid.....134
Photo Ideas and Equipment.....214

Continued on page 4

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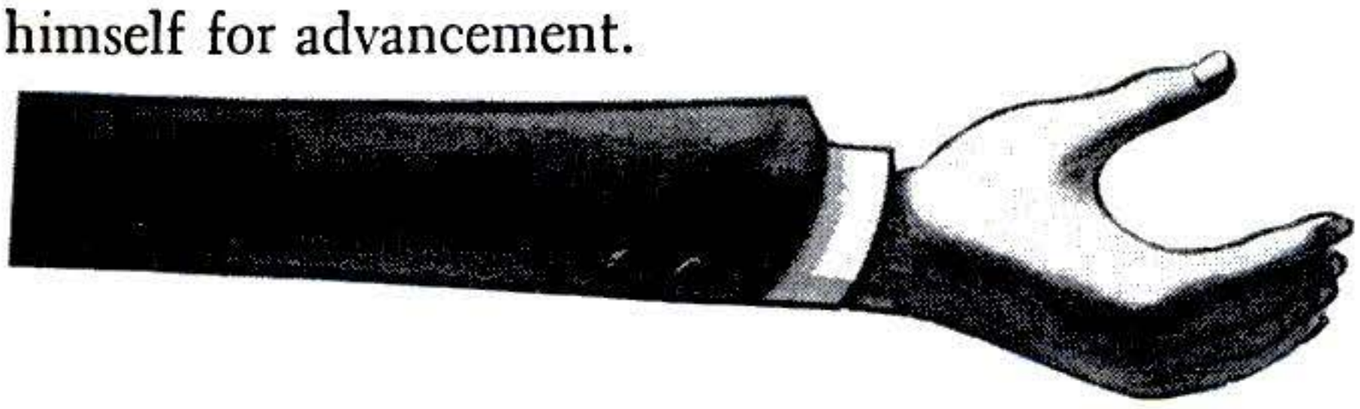

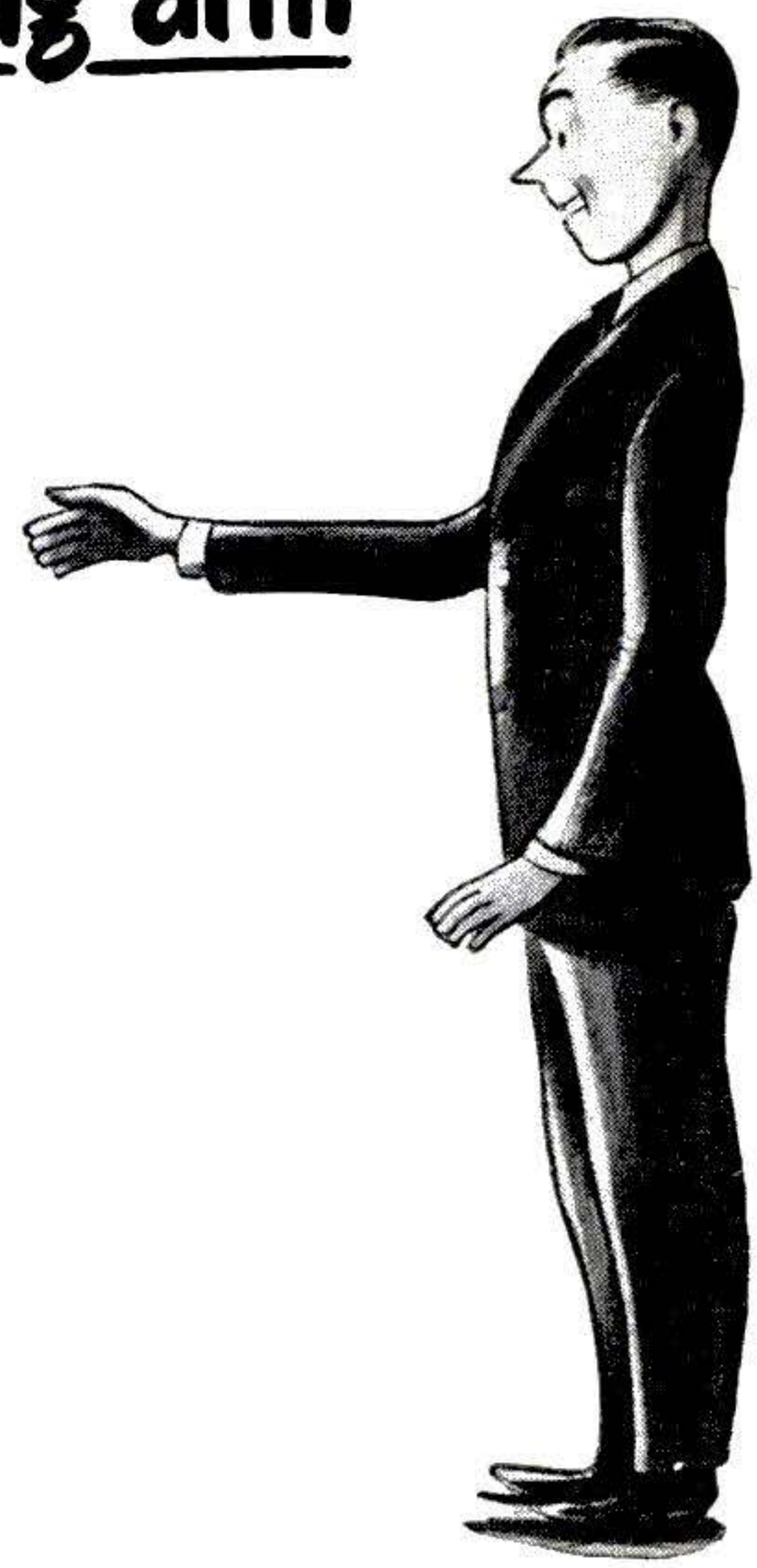

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Tin-Can Spot Highlights Pictures.....215
Turret Changes Enlarger Lens.....216
Infrared Lamp Dries Negatives.....217
Box Reflectors for Flood Lamps.....218
Desk Drawer Is Negative Viewer.....237

Mechanics & Shopcraft

Jointer Sharpened with a Jig.....192
Surfacing a Board by Hand.....200
Hinged Table Speeds Sanding.....206
Let Pumps Do the Job.....207
New Shop Ideas.....212
Hose Clamps Improvised from Wire....230
Insulation Saves Hot Water.....231
Alcohol Torch from Oil Can.....236
Broken Speed Clamp.....237
Motor Unit Runs Bike or Mower.....238
V-Belt Strips Hold Tool Bits.....239

Home Mechanics & Handicraft

1905 Steam Car Is Handsome Model....178
Oaken Bucket Goes Modern.....183
Unit Shelves Paneled with Aluminum....184
Cans Make Teakettle Candlesticks.....190
"Lamps" Serve Salt and Pepper.....191
Clamp Pedals Are Adjustable.....192
Framed Map Displays Bric-a-Brac.....196
Boarding-Ladder Bookshelf.....197
Plant Box Is Also Bird Station.....230
Making That Shade Behave.....231
Stove Bolts Hold Loose Hinges.....236
Sifter Attached to Flour Can.....239

Radio & Electricity

Mother Could Fix This Radio.....104
Pin Ball Apes Electron.....127
Corridor Traffic Light.....162
Switches Act as Door Lock.....219
Graph Adds Parallel Resistors.....219
Pocket Set Has Permeability Tuning....221
Playing Records with One Tube.....222
News in Electronics.....226
Converter Furnishes Line Voltage.....227

Departments

Letters 16
Voice of Science..... 95
I'd Like to See Them Make.....112
What's Your Ingenuity Quotient?.....193
Aids to Modern Living.....194
Craftsmen on Wheels.....198
Keeping the Home Shipshape.....204
New Tools.....220
Home Experiments.....228
For Easier Farming.....240
Editorial Memo.....286

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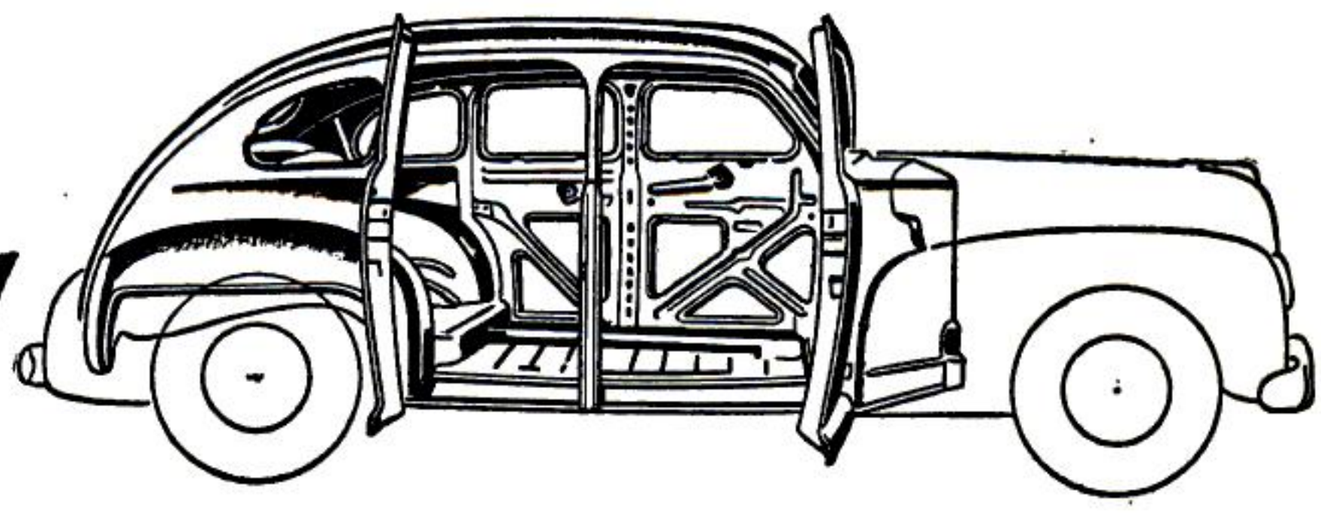
Steel, steel and more steel gives Ford its "Lifeguard" Body



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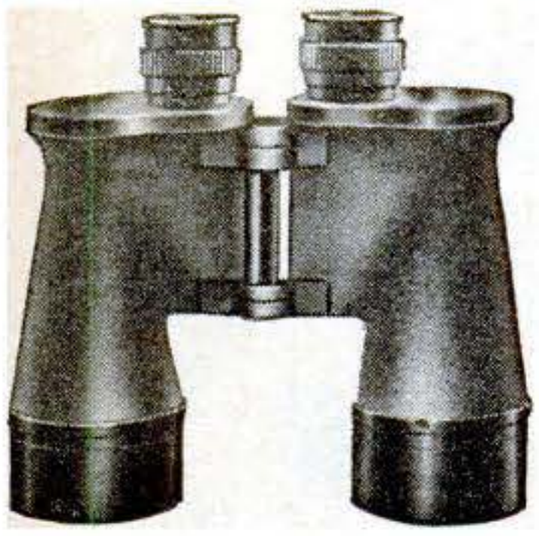

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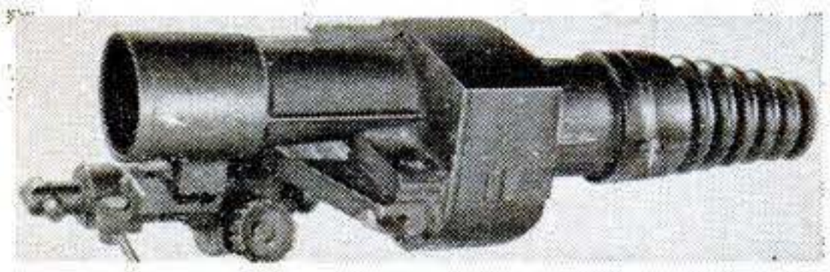

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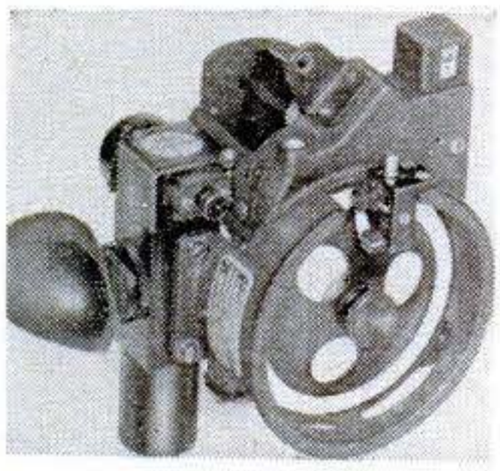

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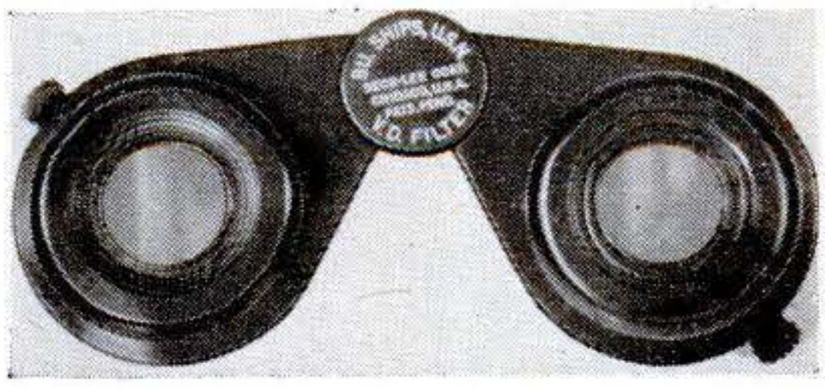

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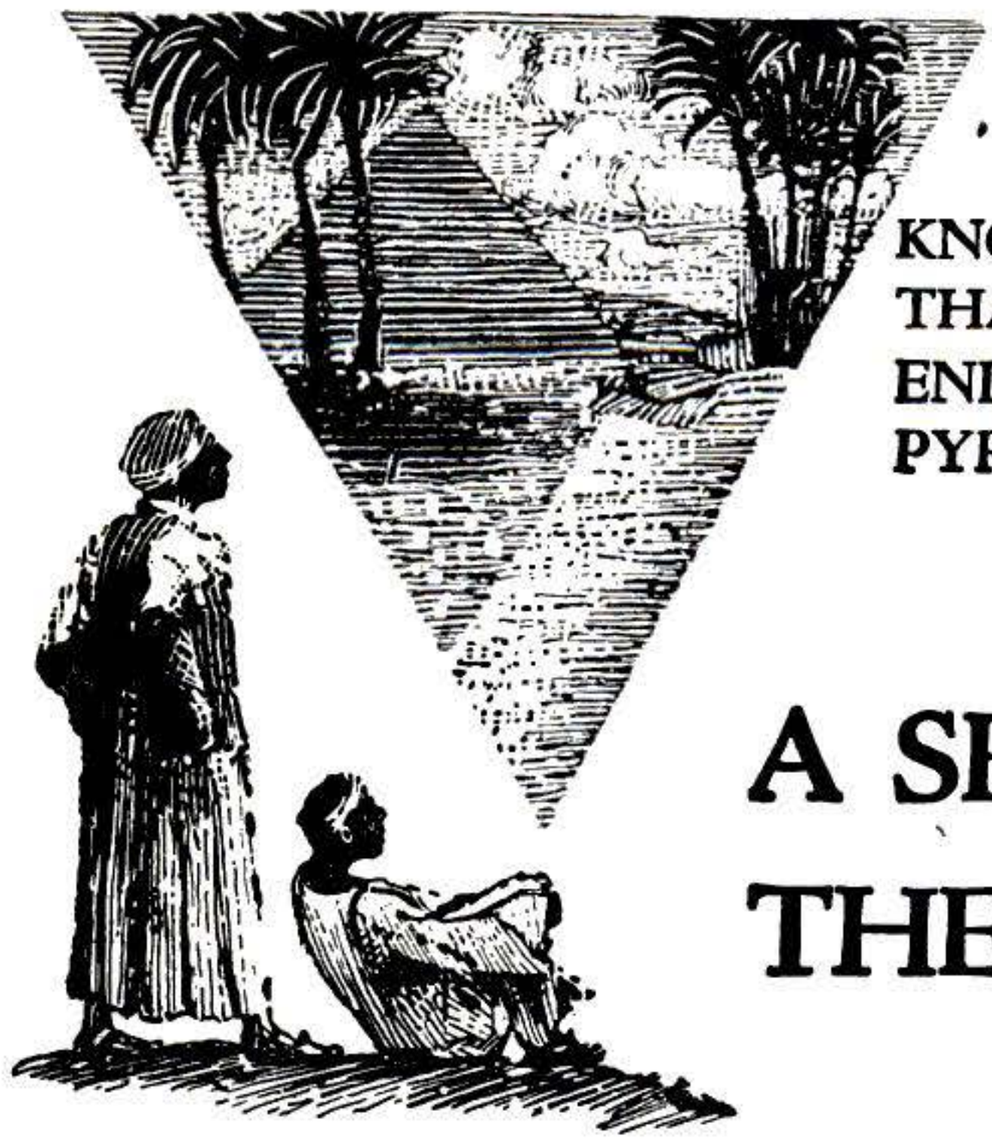

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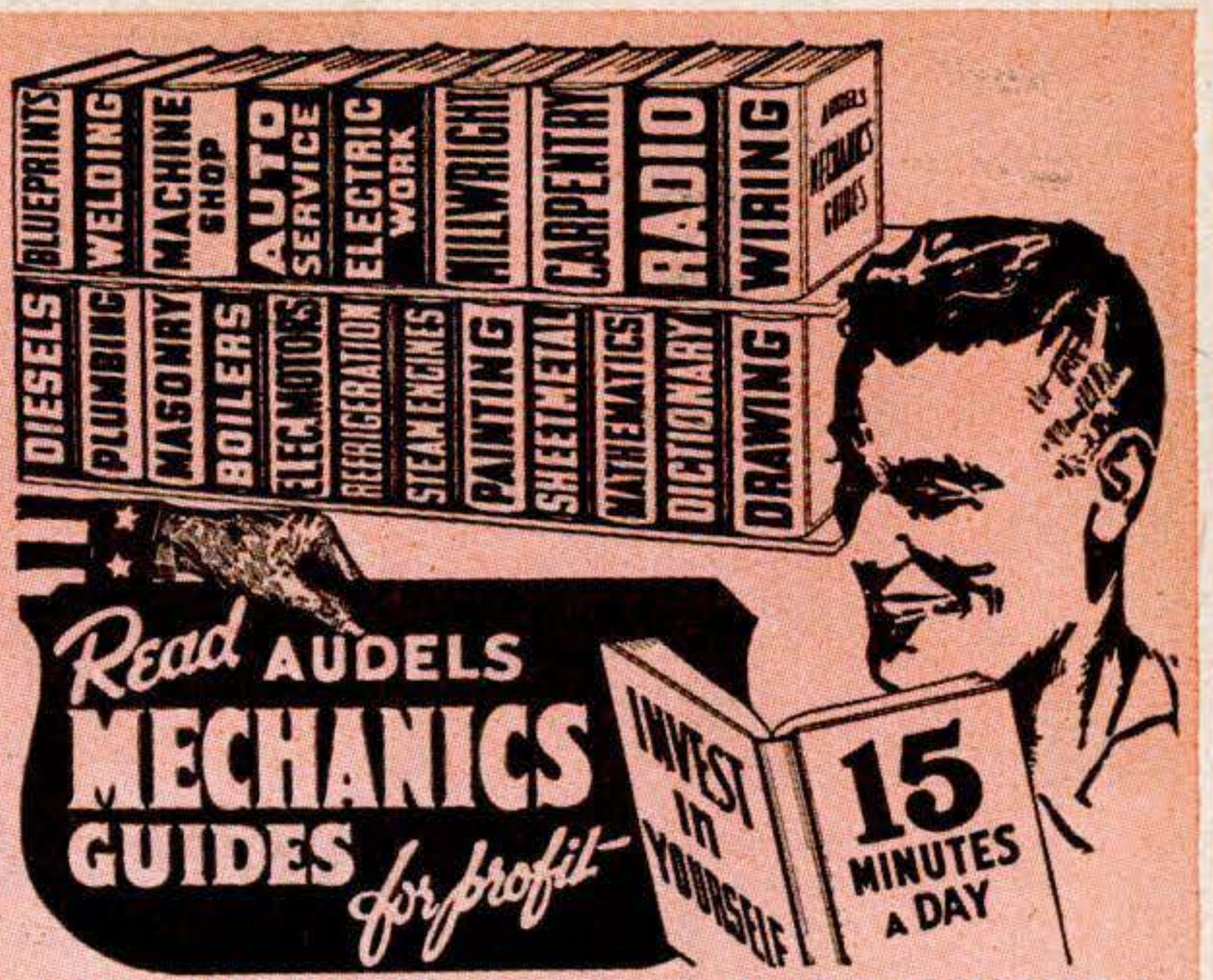

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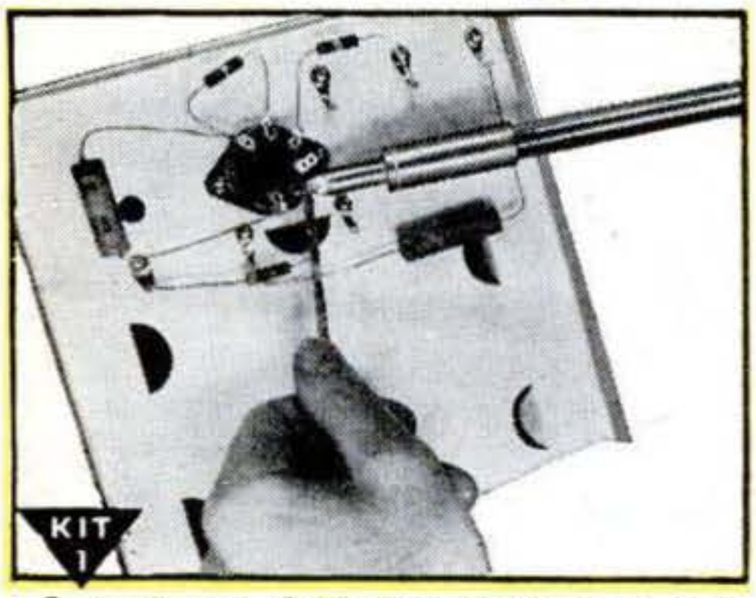

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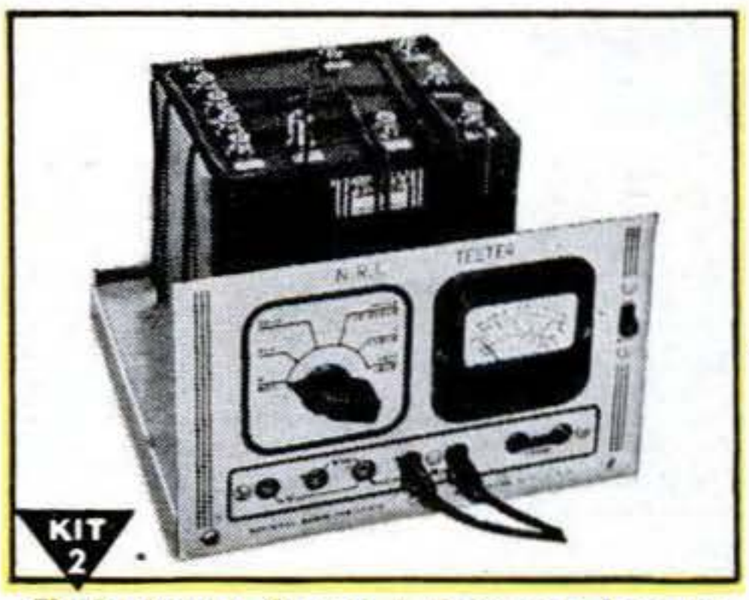

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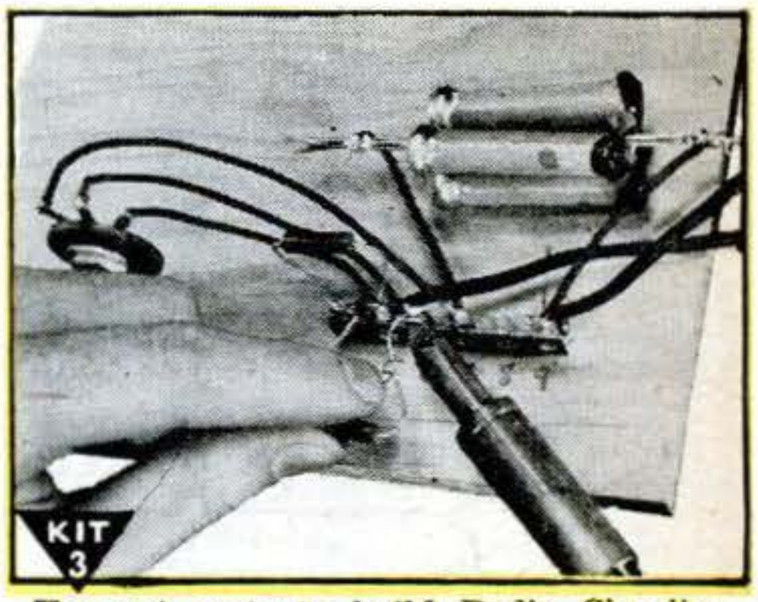

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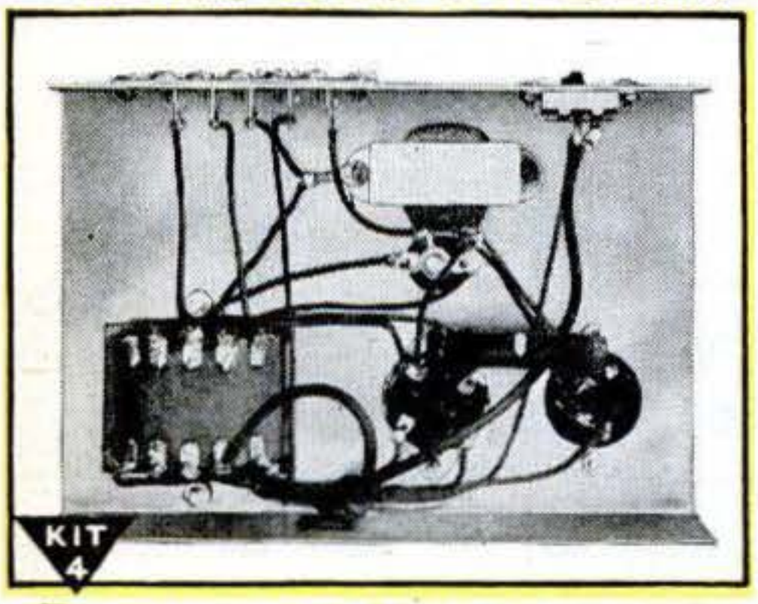

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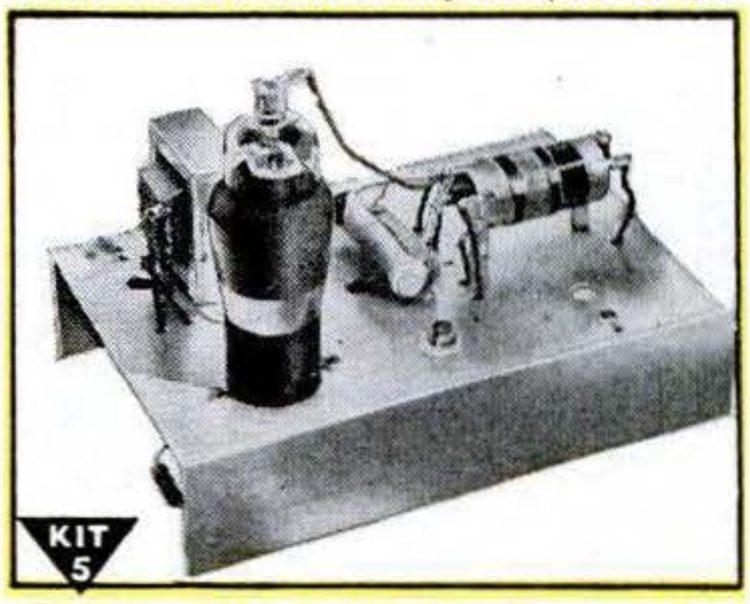

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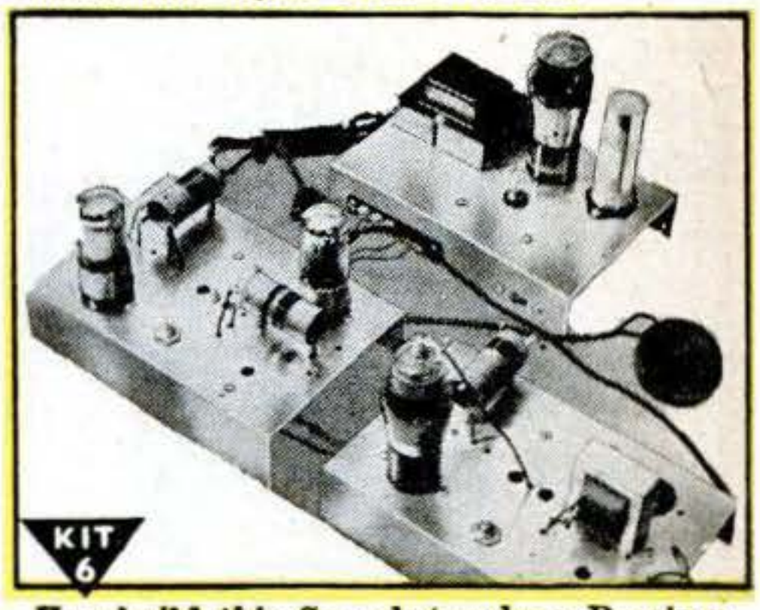

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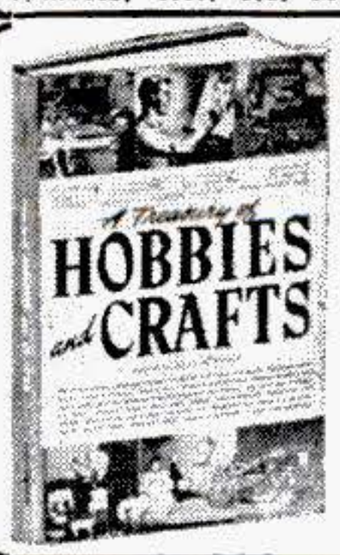
a Basic Book on Handicrafts



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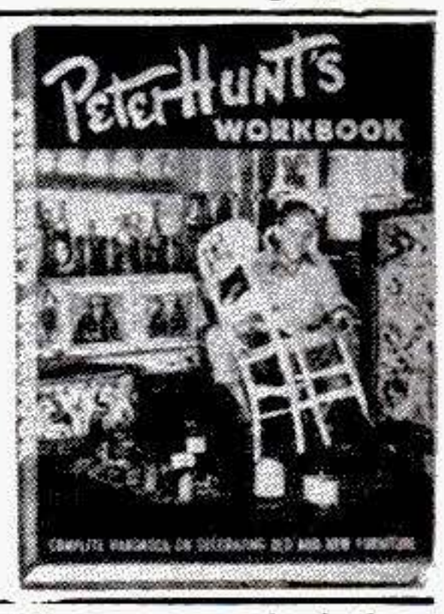

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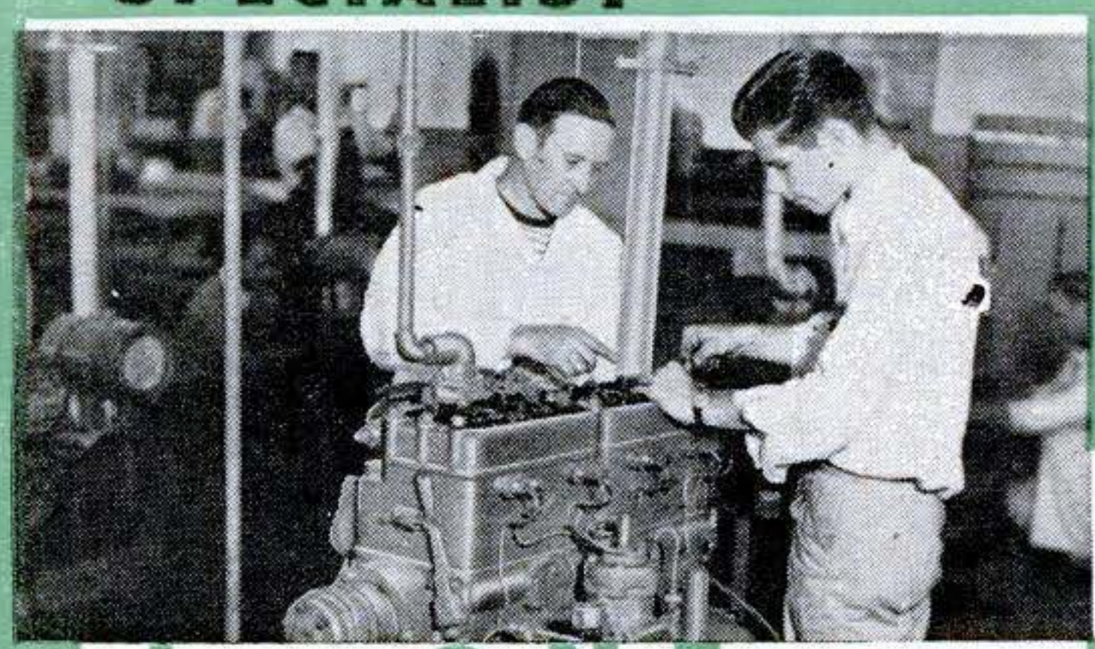

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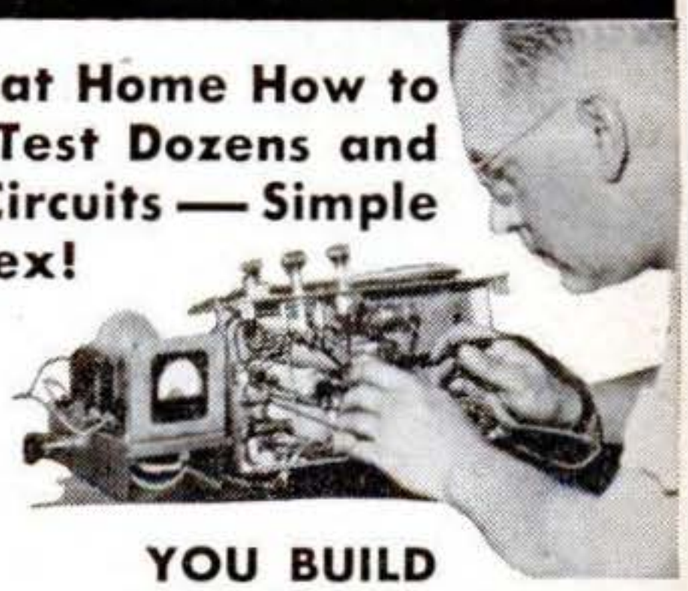

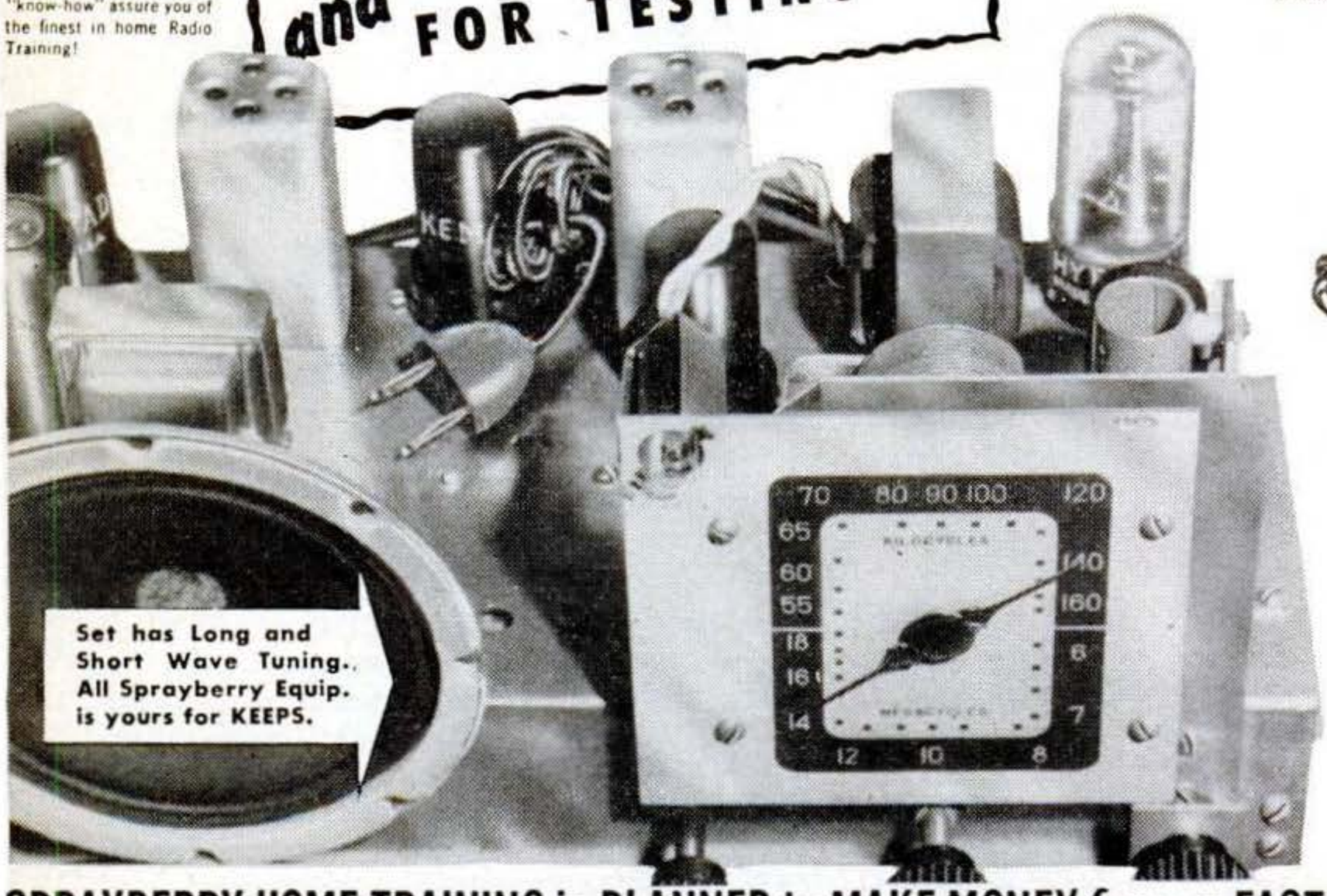

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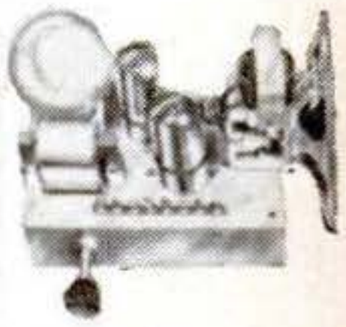
I give you a fine, moving-coil type Meter Instrument on Jewel Bearings — with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional speed and accuracy.



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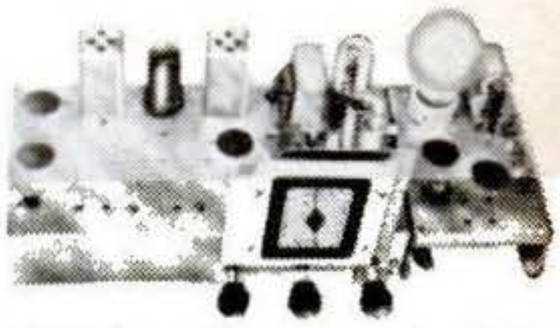

Soldering, wiring, connecting Radio parts . . . building circuits with your own hands — you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio that leads to a money-making future.

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A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

The Patent Laws were enacted for the benefit of the inventor to give him protection for the features of his invention which are patentable. These features must be properly and concisely set forth and claimed in a formal application for patent, in order to comply with the requirements of the U. S. Patent Office. For that reason, the Patent Office advises the inventor, unless he is familiar with such matters, to engage a competent registered patent attorney or agent to represent him. We maintain a staff of registered patent attorneys ready to serve you in the handling of your patent matters.

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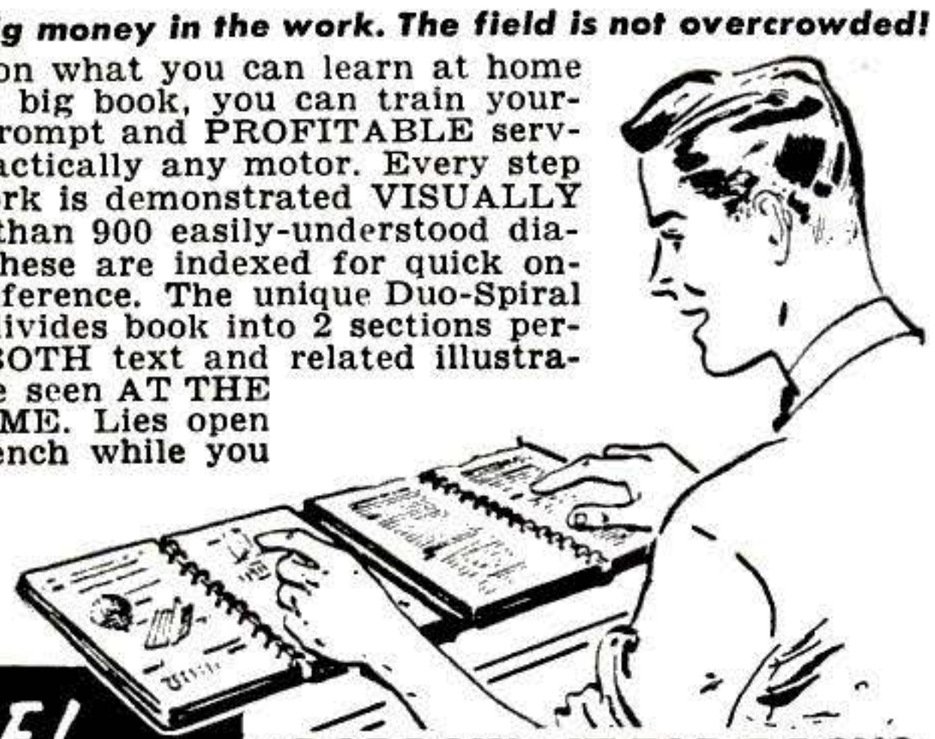

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LETTERS

On the Wings of Praise

Sir:

It is the wish of the Aircraft Owners and Pilots Association to extend most hearty congratulations to POPULAR SCIENCE for the courageous stand taken on the matter of aircraft safety in the editorial, "Don't Blame Science for This!" (Oct. '47, p. 7).

AOPA has for many months been urging the adoption of GCA (Ground Control Approach), and we can heartily endorse the text and sentiments of your thought-provoking editorial.

J. B. HARTRANFT, JR.
General Manager
Aircraft Owners and Pilots Association
Washington, D. C.

Sir:

I have just had the opportunity to read your editorial on GCA in the October issue.

Please accept our gratitude for your forceful championing of GCA. . . .

LEONARD DAVID CALLAHAN
Director of Public Relations
Radar Division
Gilfillan Bros., Inc.
Los Angeles, Calif.

Picture Our Surprise

Sir:

On page 92 of the October issue, I noticed a photograph of a movie camera on a wheeled stand taking pictures recording the wave patterns of a supersonic wing. The caption described this camera as a 35-mm. camera. I believe, however, that the camera pictured is a 16-mm. Ciné-Kodak Special. Am I wrong?

WILLIAM BERGER
The Bronx, N. Y.

To Mr. Berger and the other sharp-eyed photo experts who were also bothered by this mislabeling, PS makes a blushing apology. The camera is a 16-mm. model.

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If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

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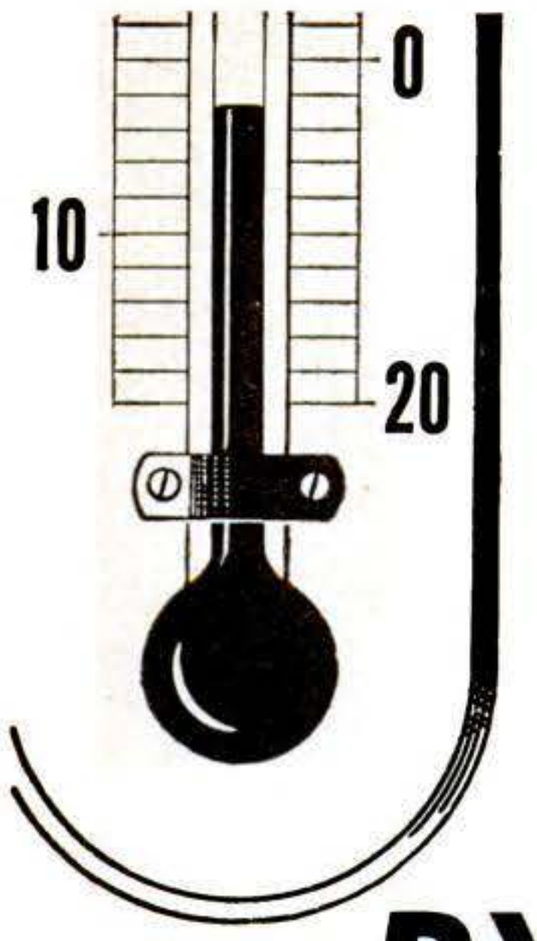

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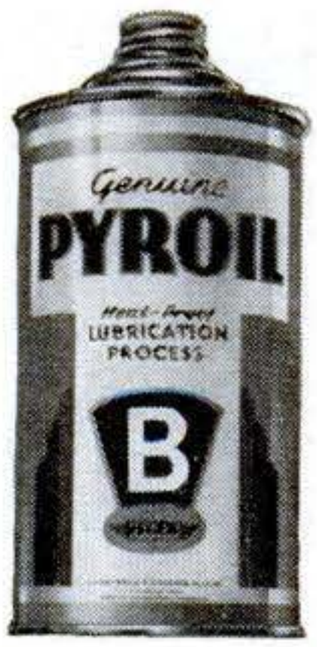

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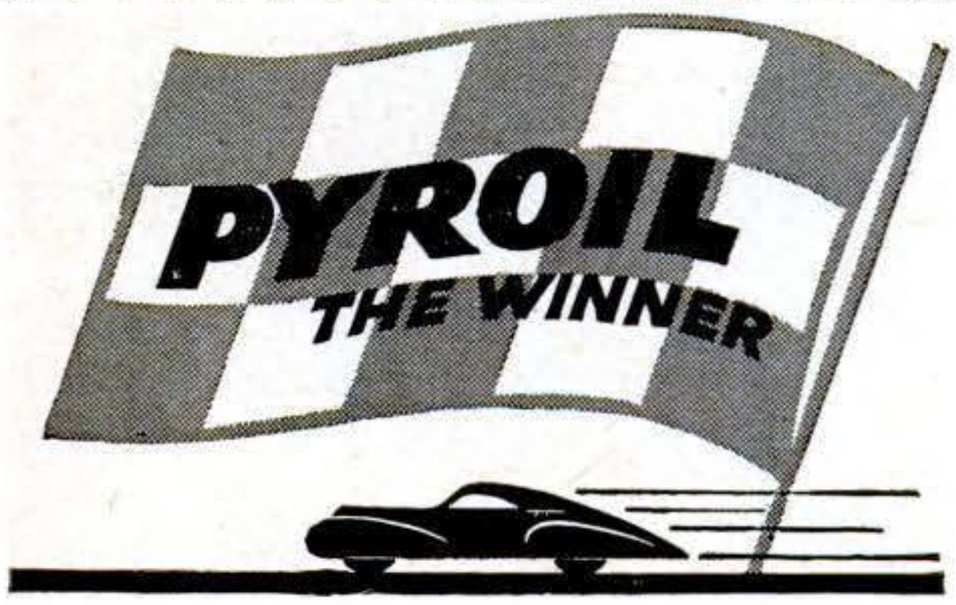


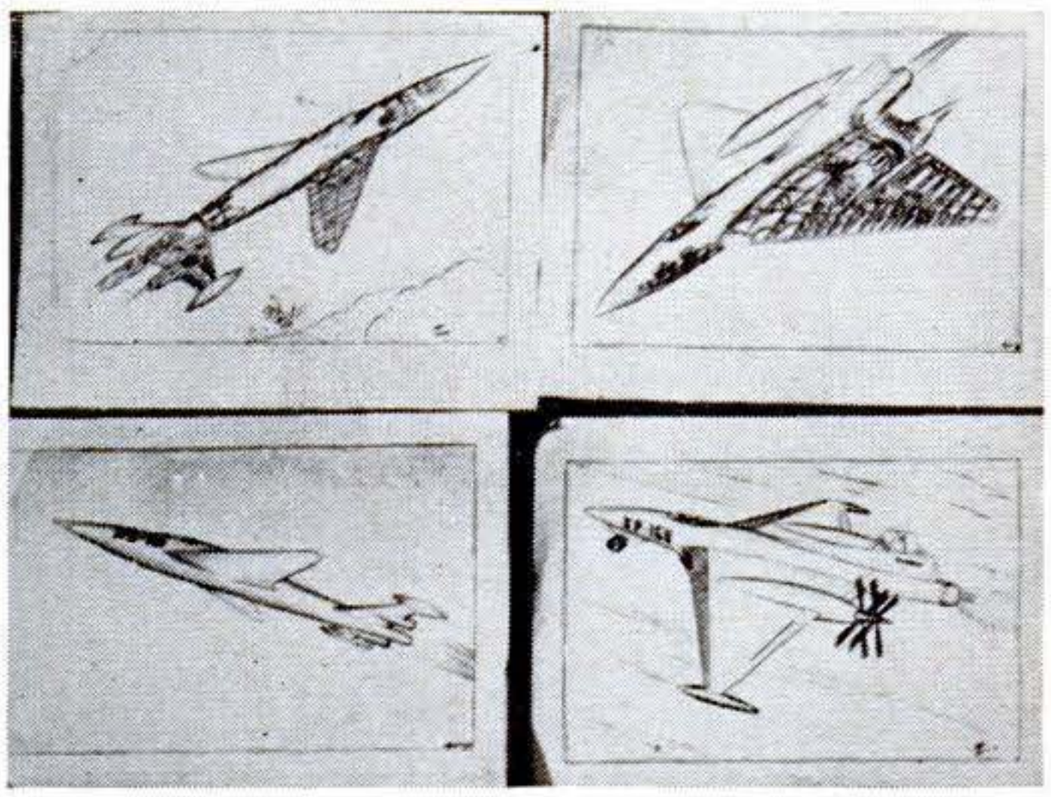
Things that Came

Sir:

I have been interested in jet propulsion for some time. Here (below) are some drawings I did depicting some of my own ideas for supersonic aircraft. . . . These were done about two years ago. At that time they were radical but today appear orthodox, showing the great strides made in aviation.

JOHN M. GASKA

Amsterdam, N. Y.



Whoopee—It Works!

Sir:

I have constructed your model gas engine from Mr. Magee's articles (June-Aug. '46) and am writing to tell you how pleased I am with both the work sheets and the finished article. . . . The motor was completed just in time for entry into The Royal Adelaide Exhibition of 1947, where it won first prize in its class. . . .

R. W. ELLIS

Hyde Park, South Australia

An Ounce of Prevention

Sir:

So-called "scientists" . . . run hither and yon scaring folks out of their wits with gigantic fabrications of the awful blast of A-bombs. . . . Here is my plan:

1. Construction of a series of underground chemical plants capable of processing the basic foods from their natural state to pure concentrates. . . . Feeder plants located near by would supply from local "greenhouses" the necessary phosphates and minerals. . . .

2. Development of special Geiger counters to provide the necessary monitoring of fissionable and radioactive materials. . . .

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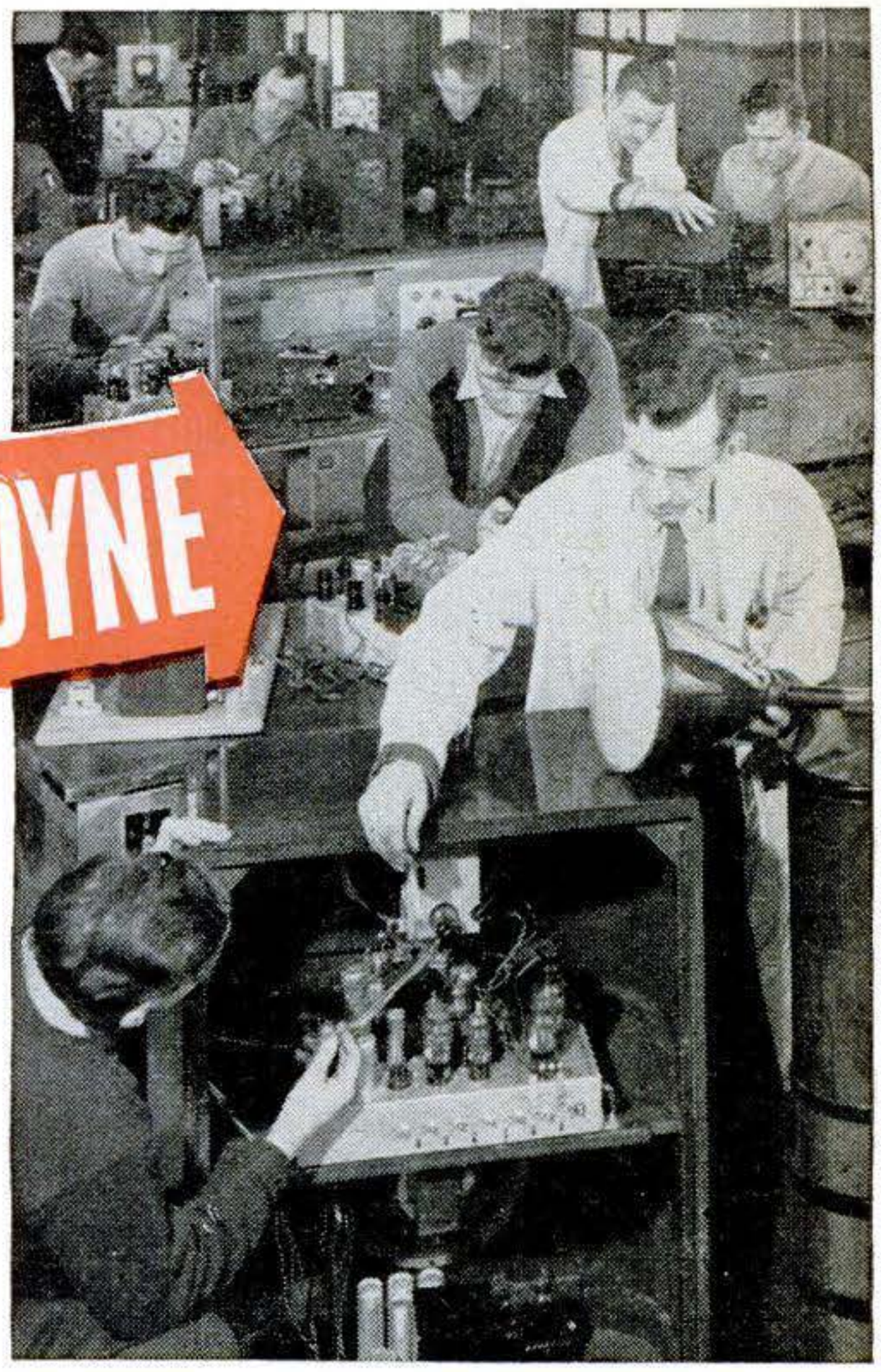

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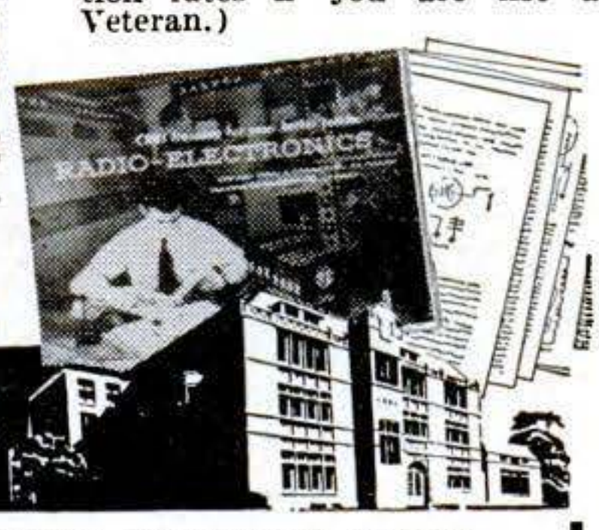

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Gentlemen: Please send me a free sample lesson and your free booklet, "CREI Training For Your Better Job in Radio-Electronics" describing opportunities and CREI home study courses in Radio-Electronics and Television.
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3. Development of a complete system of distillation plants capable of supplying enough decontaminated water for the entire U. S.

4. Manufacturing facilities capable of turning out millions of small Geiger counter outfits to supply any and all needs of individuals, villages, central kitchens, etc.

5. Provide necessary counting equipment for all water systems. . . .

C. G. Bacon

Scotia, N. Y.

Another idea would be to build enough big rockets to transport the nation's 140,000,000 people and their chattels to the moon. A better defense than either plan, however, would be to maintain peace.

More on Mailboxes

Sir:

Lest some of your readers find themselves on the wrong end of a government regulation for attempting to imitate those colorful mailbox designs ("Dressing Up the RFD," Dec. '47, p. 128), I quote a letter from J. M. Donaldson, then First Assistant Postmaster General, who explains that the Postal Dept. now only approves rural mailboxes of a standard, all-metal design:

"The boxes are built for the greatest convenience of the rural carriers and the greatest protection for the mail. The Department desires, as far as possible, that patrons use these standard boxes. During the war years when metal was not available, the restrictions on mailboxes were lifted in order that some receptacle would be provided. Now, however, it is the intention of the Department to require standard boxes from all new patrons and on newly established routes.

"Patrons of the rural routes will be encouraged to replace the present unsatisfactory boxes with standard rural boxes as quickly as possible. If patrons make their own boxes, they must conform as closely as possible to the approved type of box, and the completed box must be satisfactory to the postmaster before mail will be delivered.

"The approved boxes may be beautified in any manner the patron desires if it does not interfere with door or signal flag."

Clifton Abbott

Western Ways Features
Tucson, Ariz.

Oh, well—there's always paint.

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Yours truly, R. M. Gray

Dear Sir:

I have the practical experience—eight years of it. What's more, an I. C. S. Course in Automobiles has given me a thorough working knowledge of automobile construction, maintenance, operation and repair.

This training has carried me to the top in my present position. Two years ago, I was put in charge of our three-man repair shop. My employer will tell you I've done a good job.

Yours truly, P. Packard

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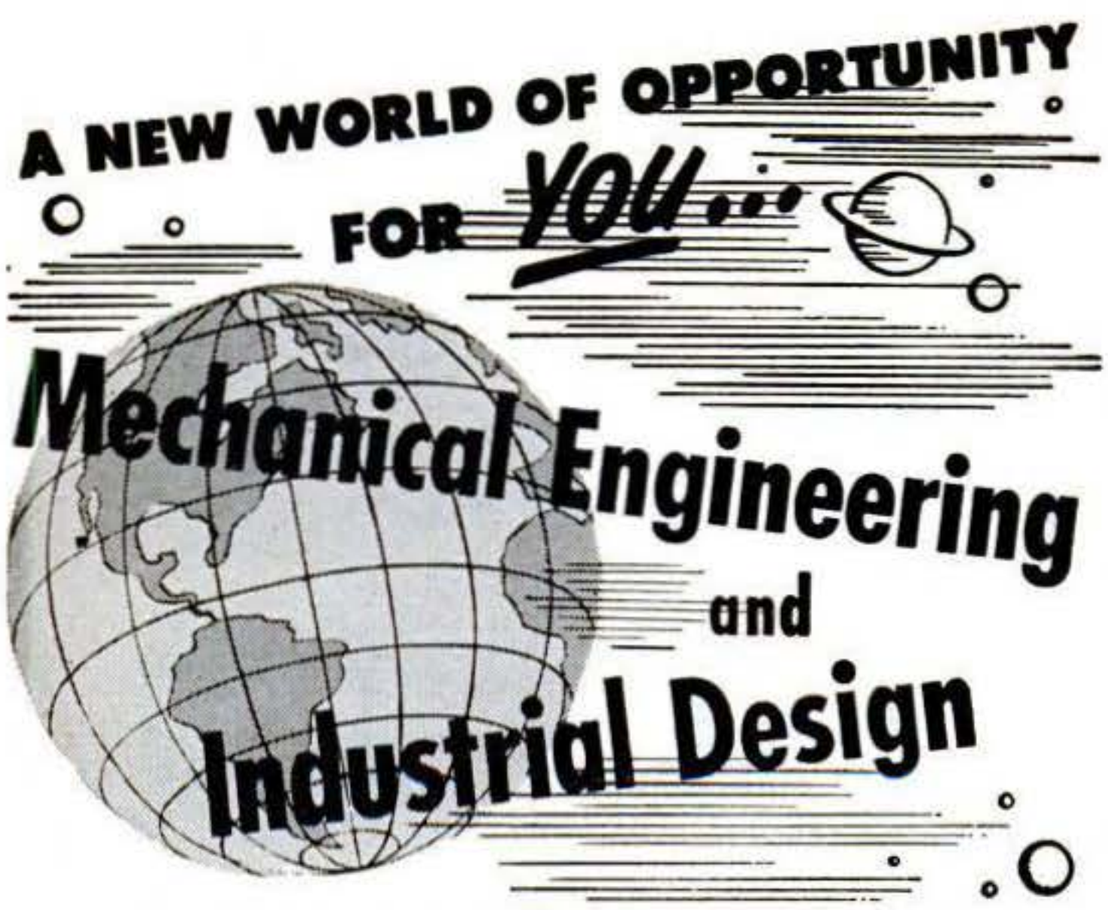

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Modules—Pro and Con

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We have a lot that slopes both north and south with a wonderful view to the north from east to west. I can think of no better way of taking advantage of these features than by building the house you show. . . .

(Mrs.) DOROTHY BROWN
Calgary, Canada

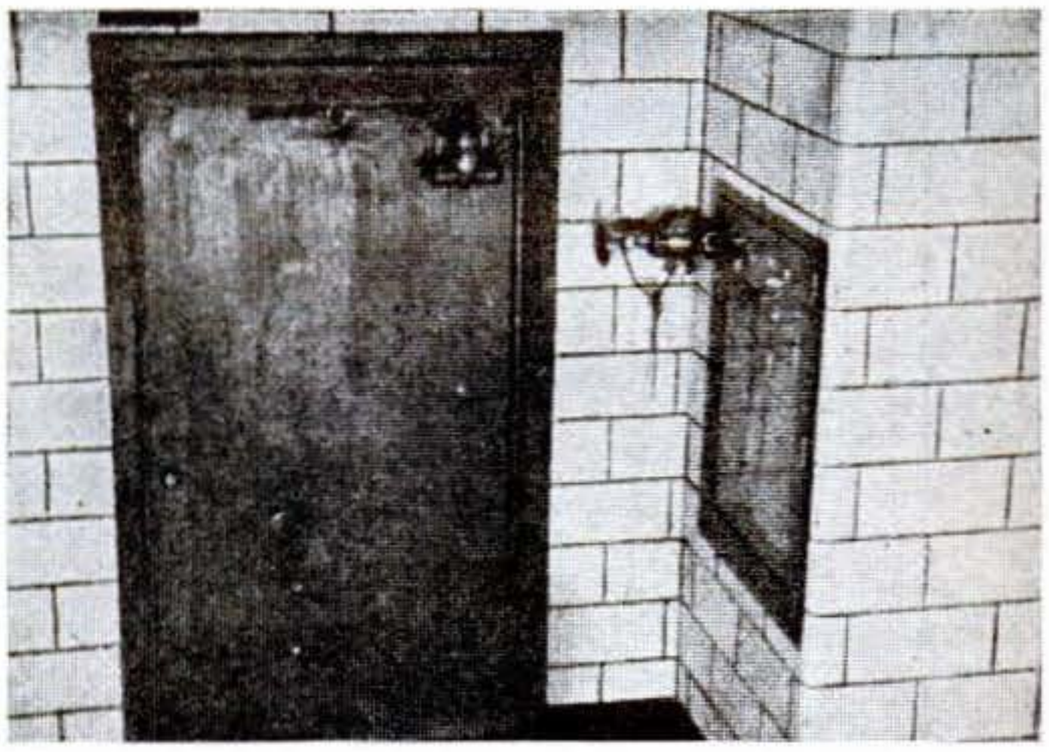
Sir:

I would like to take issue with your article, "Housing Cost Cut By New Cubic Unit."

The point that first prompted me to write is the obvious error in the description of photograph No. 2 in which it is stated: "It takes this man from three to five minutes to slice each tile to make it fit." We would be glad at any time to prove that a 4 x 5 x 12-inch vitrified salt or ceramic glazed tile can be cut in two in 25 seconds. . . .

Secondly, under photograph No. 3 you say: ". . . see how many tiles had to be cut around the doorway and fire extinguisher niche." I have been studying it for several minutes and so far can't find any. . . .

ROBERT G. EVANS
Clipper Manufacturing Company
Kansas City, Mo.



Look again. Half units were used at sides of doorway, but the above picture, reproduced from the one appearing in the article, clearly shows the number of tiles that had to be individually cut around the fire extinguisher niche. As for the cutting time, PS was referring to the entire operation of measuring, cutting, and fitting, which can run to several minutes per tile.

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ADVICE *for the* INVENTOR

The United States Patent Office advises the inventor, unless he is familiar with such matters, to employ a competent registered patent attorney or agent as the value of patents depends largely upon the skillful preparation of the specification and claims.

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The Evidence of Invention form mentioned below is offered as a convenience to the inventor in making his disclosure of invention.

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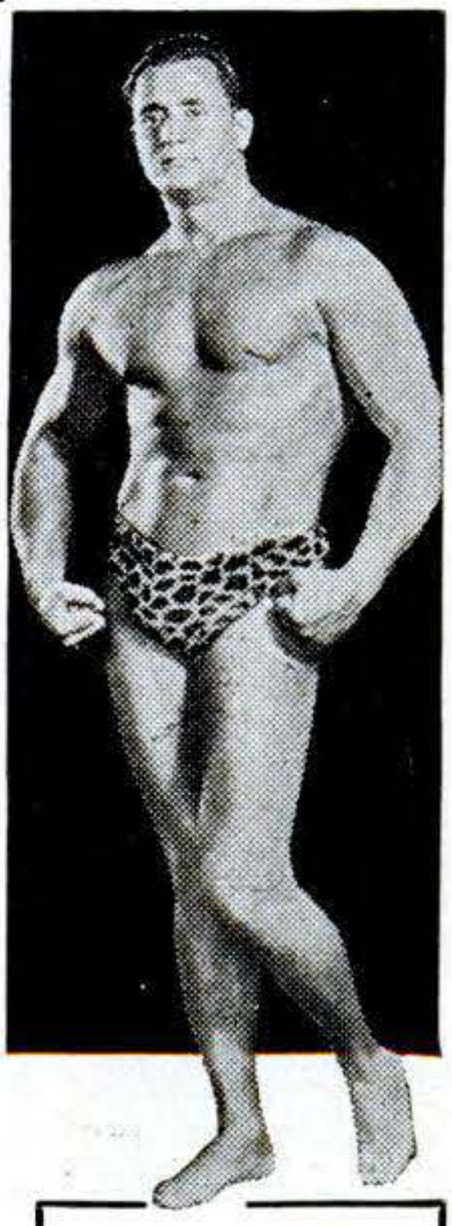
who became "The World's Most Perfectly Developed Man"

"I'll Prove that YOU, too, can be a NEW MAN!"

Charles Atlas



CHARLES ATLAS
Holder of title, "The World's Most Perfectly Developed Man."

I KNOW, myself, what it means to have the kind of body that people pity! Of course, you wouldn't know it to look at me now, but I was once a skinny weakling who weighed only 97 lbs.! I was ashamed to strip for sports or undress for a swim. I was such a poor specimen of physical development that I was constantly self-conscious and embarrassed. And I felt only HALF-ALIVE.

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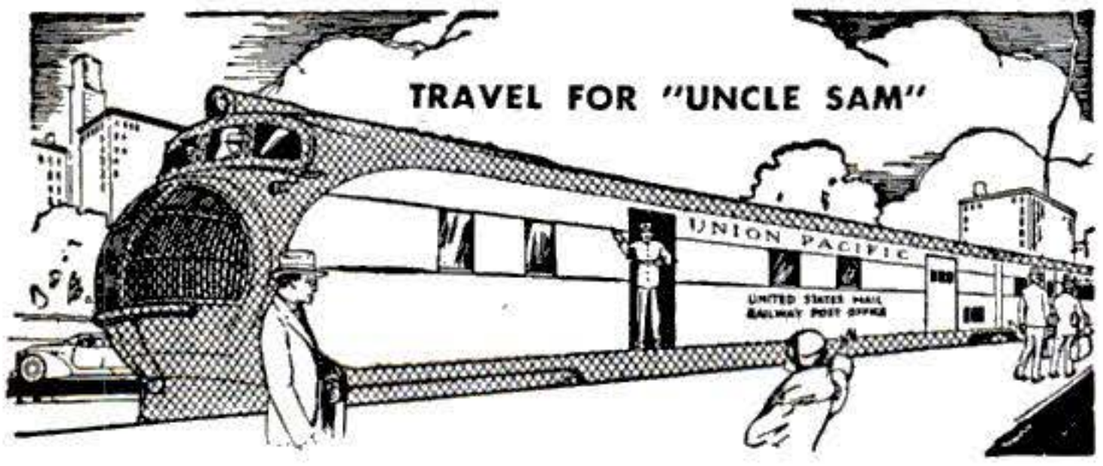

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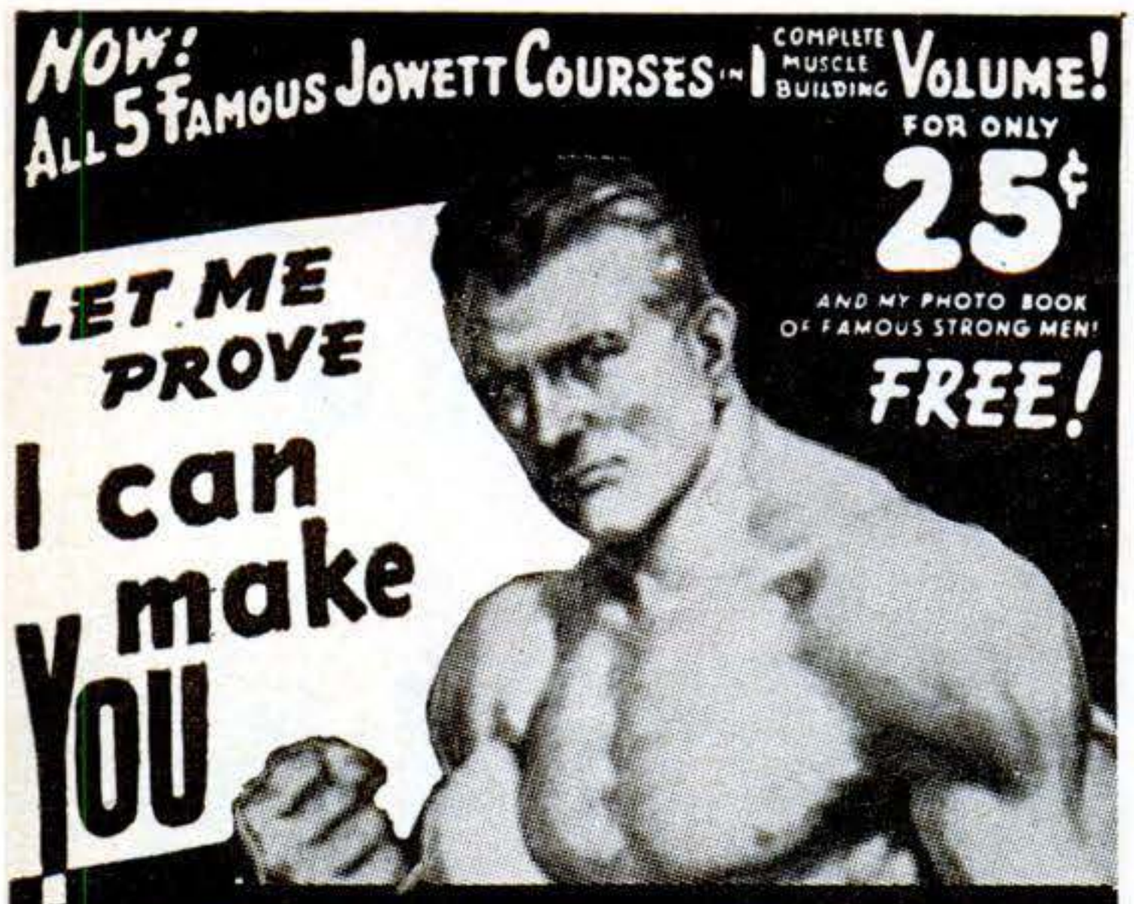

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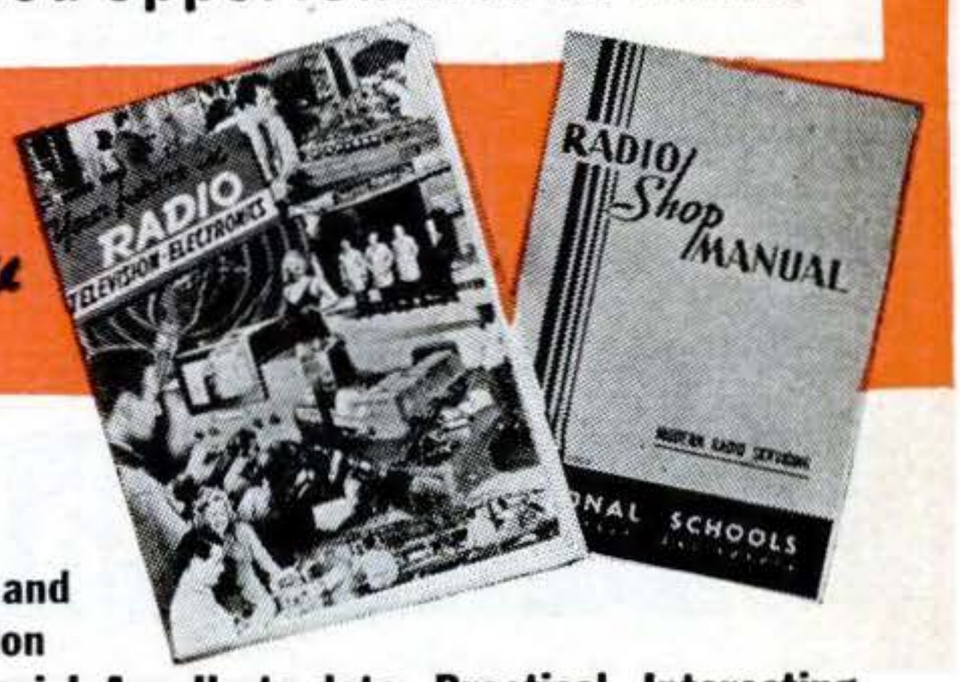

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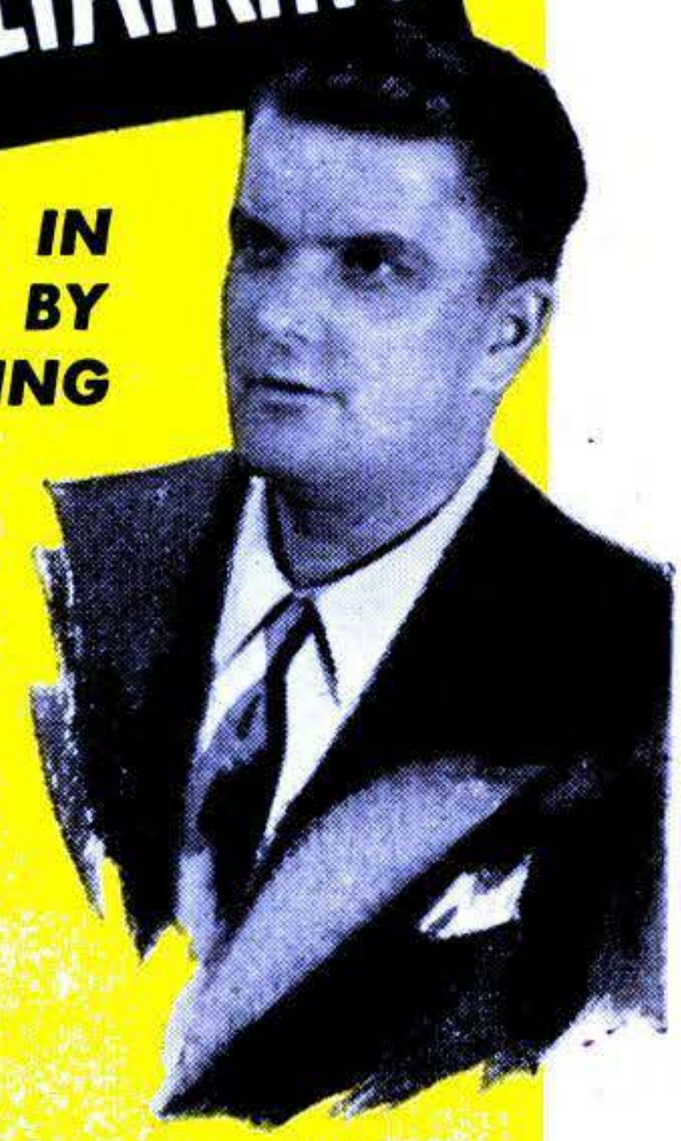

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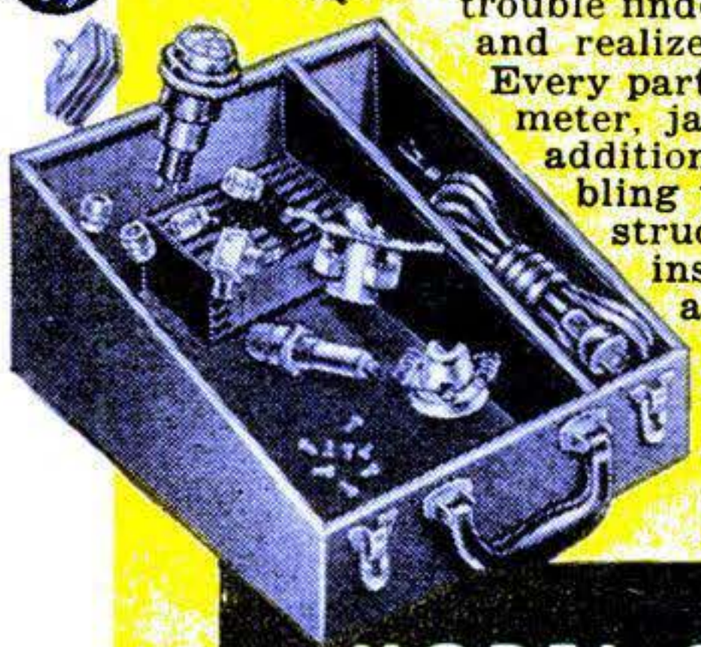

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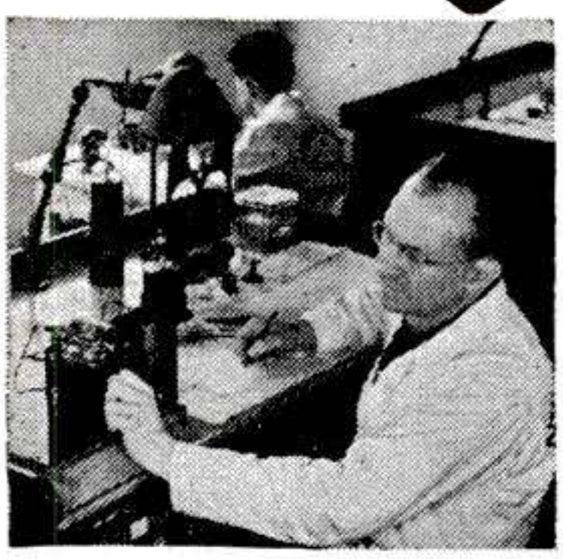

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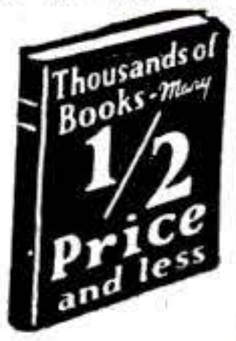

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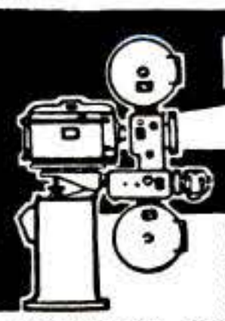

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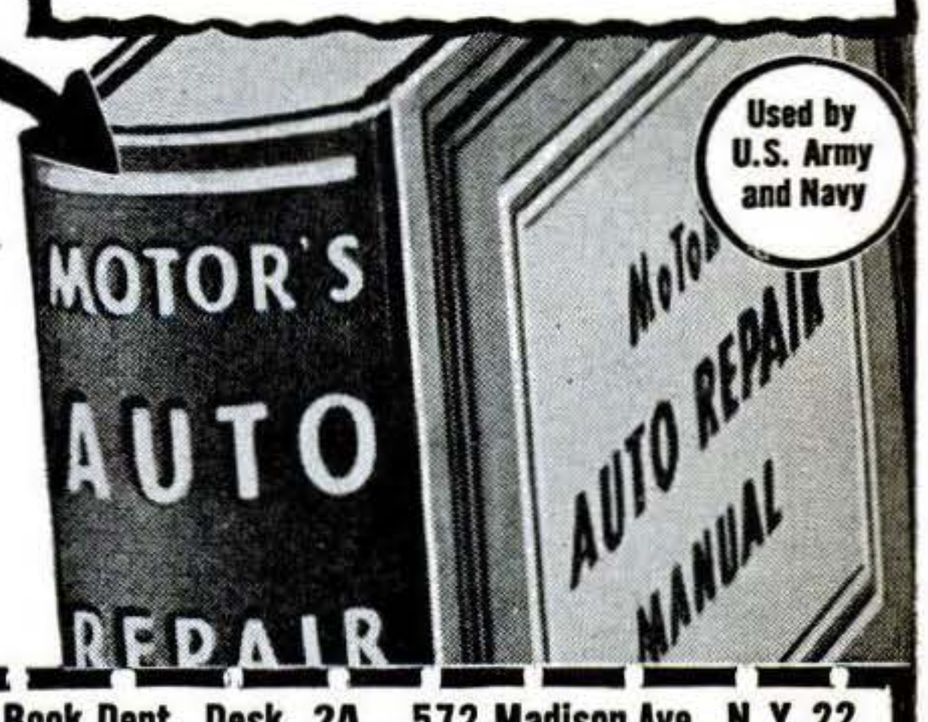

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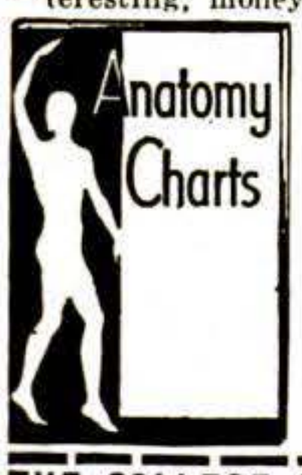

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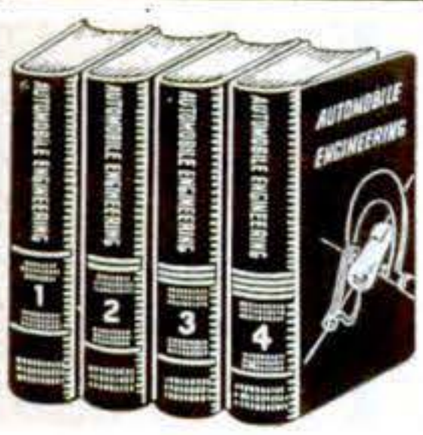

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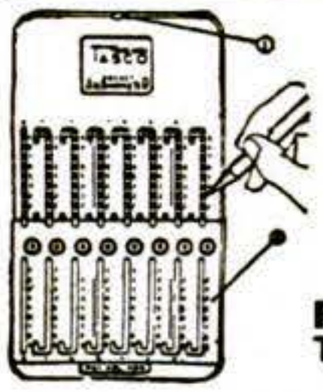

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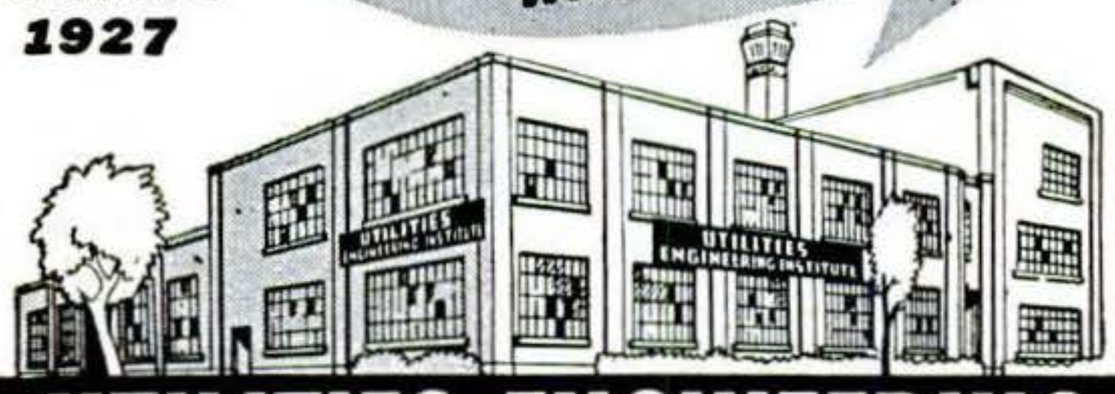

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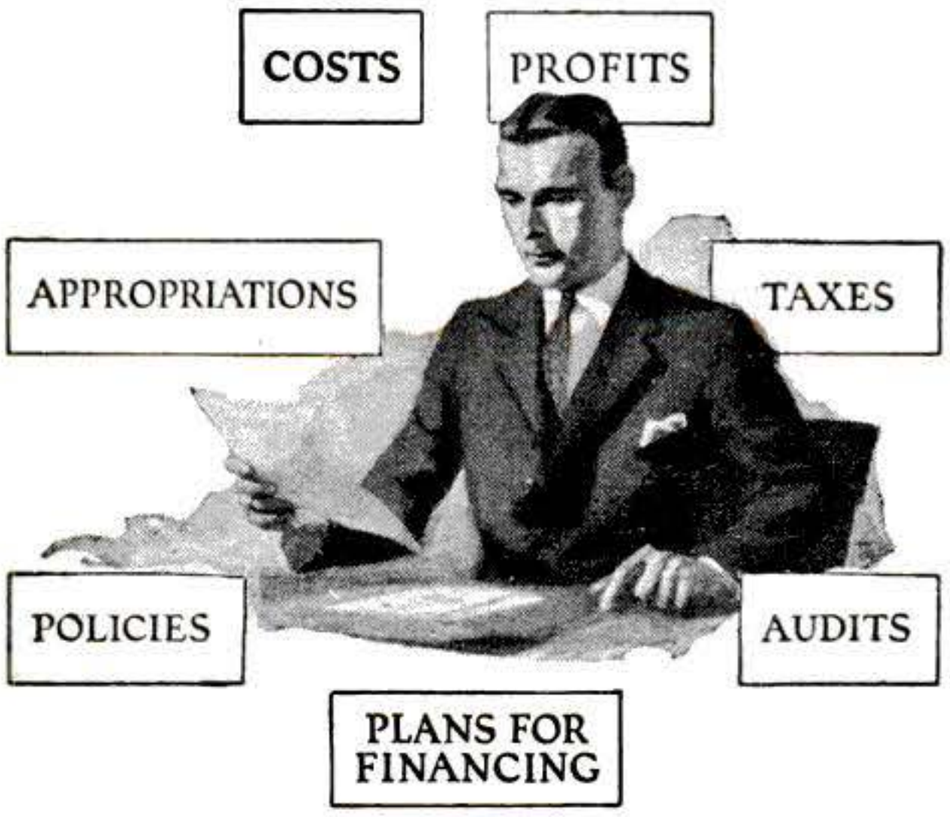

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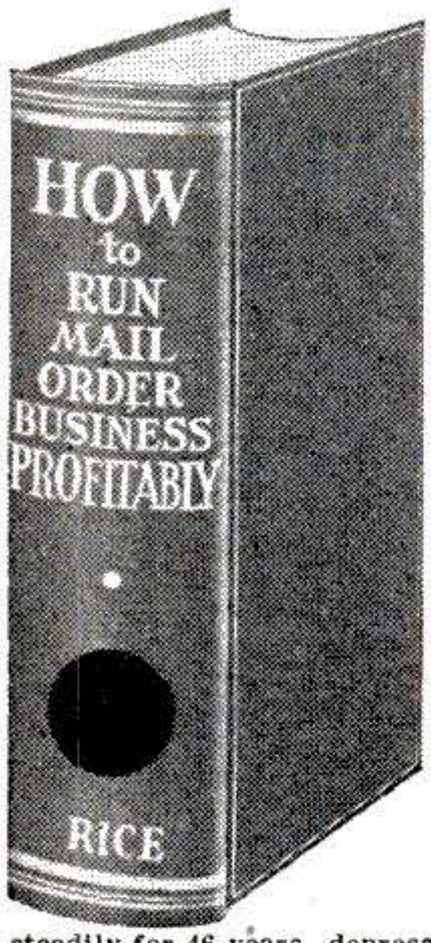

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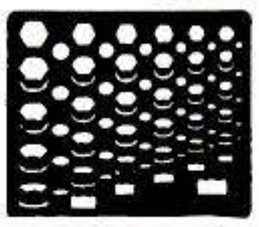

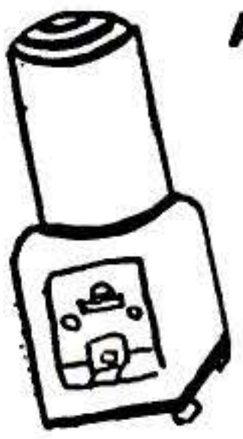

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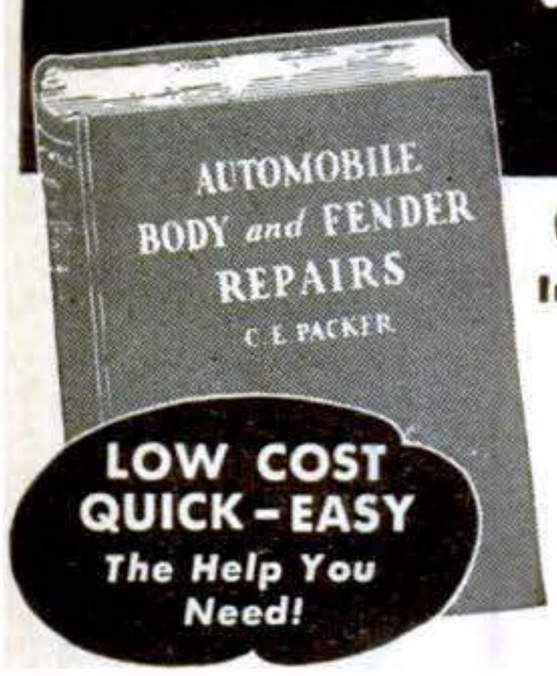

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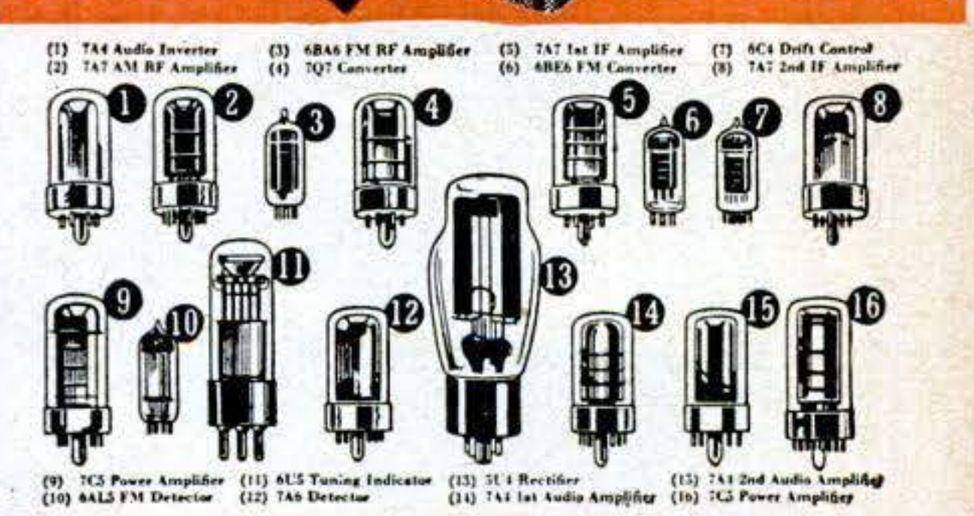

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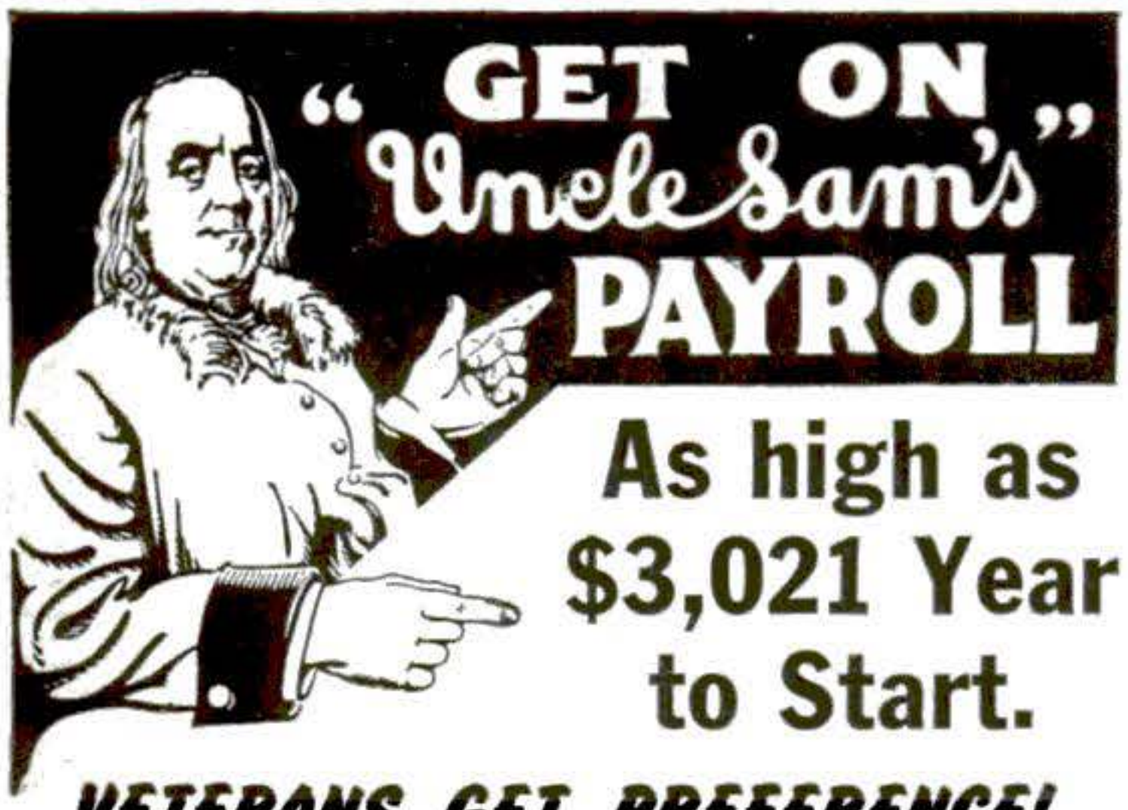

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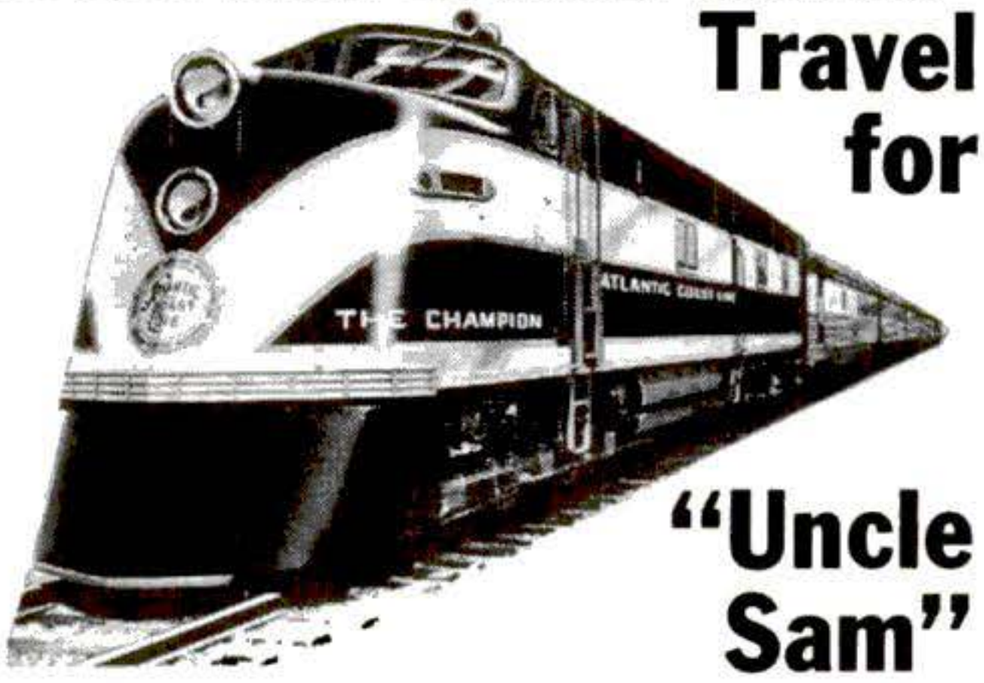

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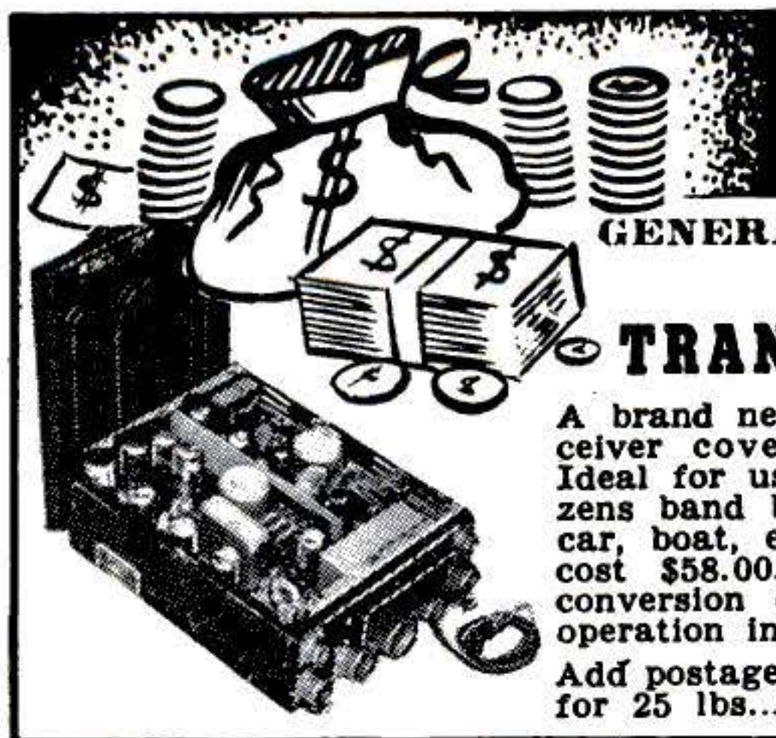

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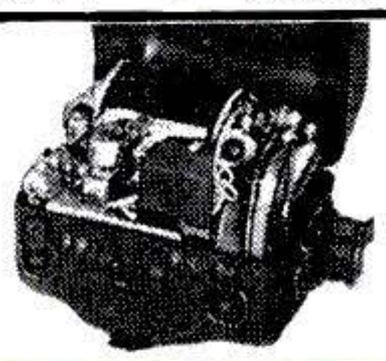

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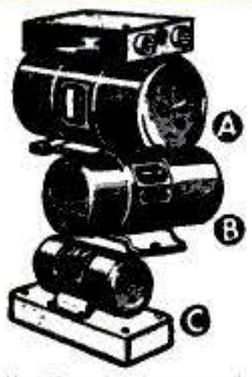

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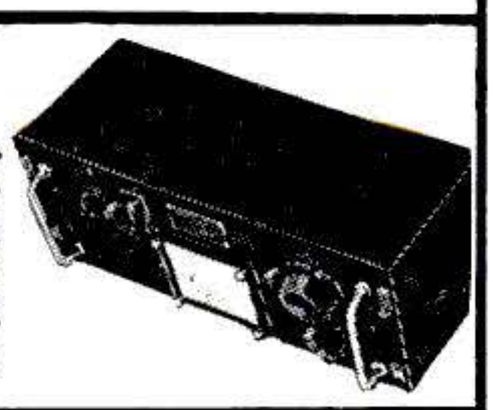

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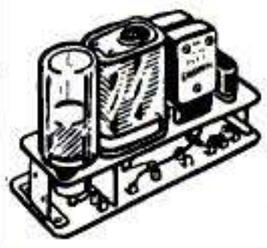

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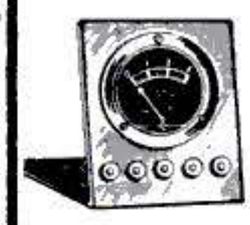

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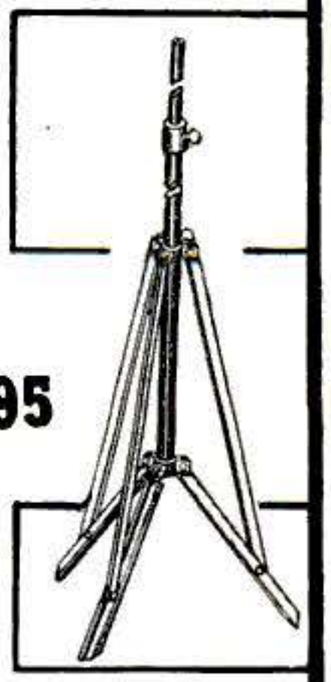

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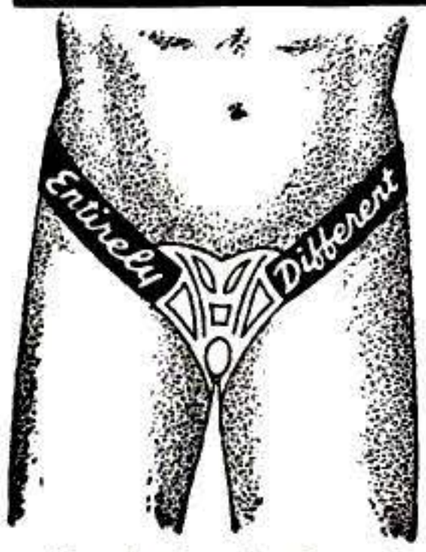

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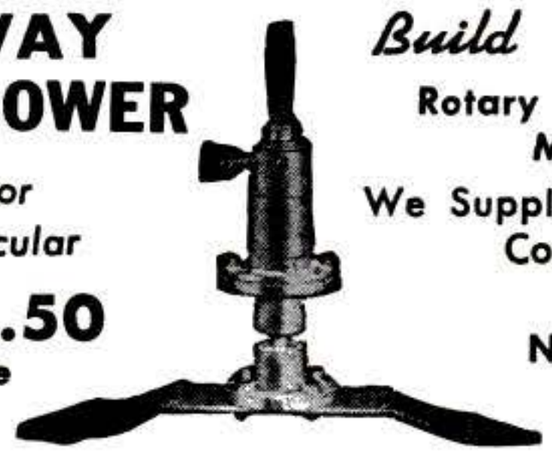

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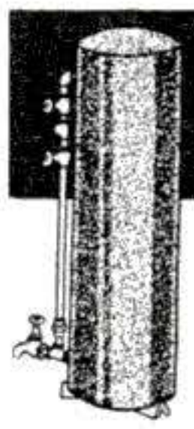

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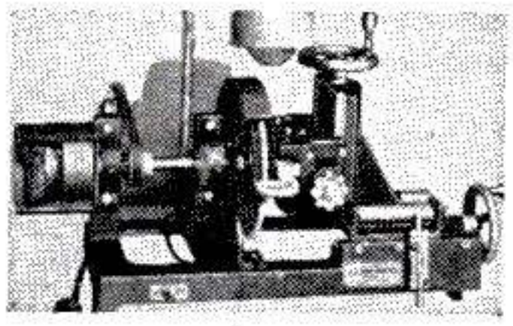

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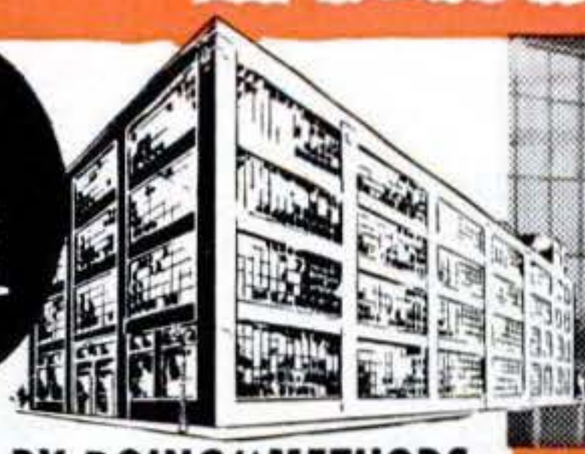

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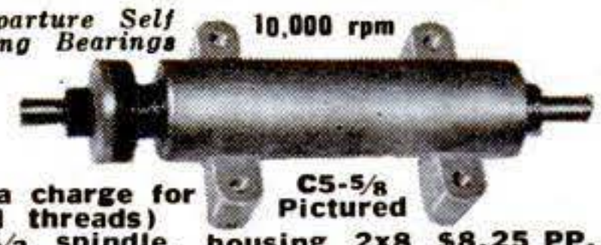

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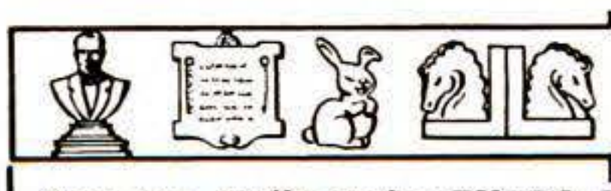

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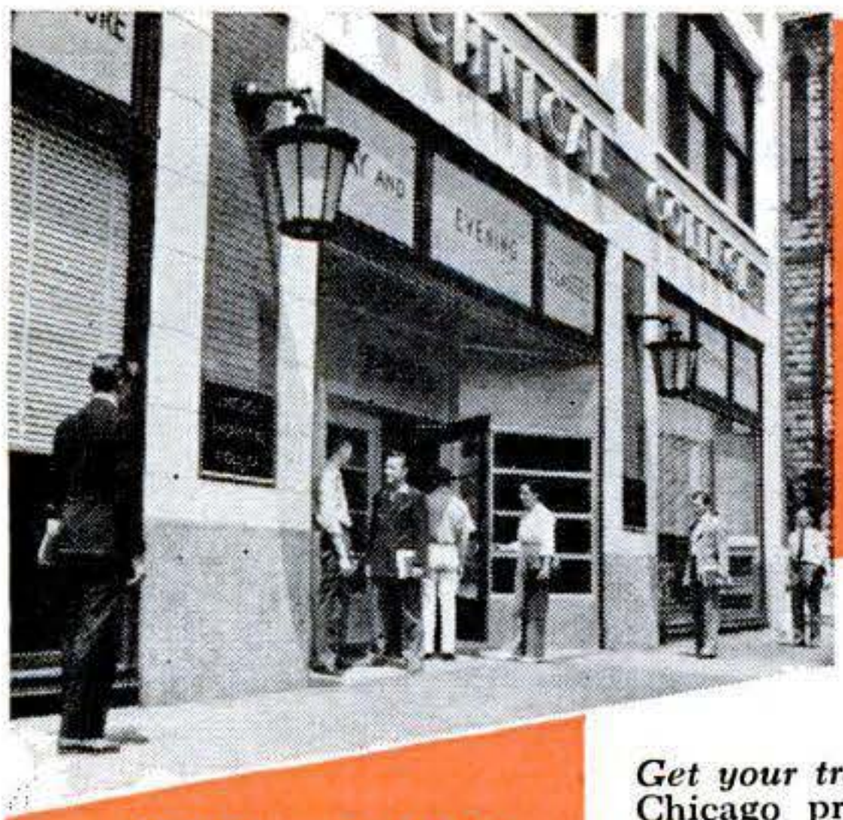

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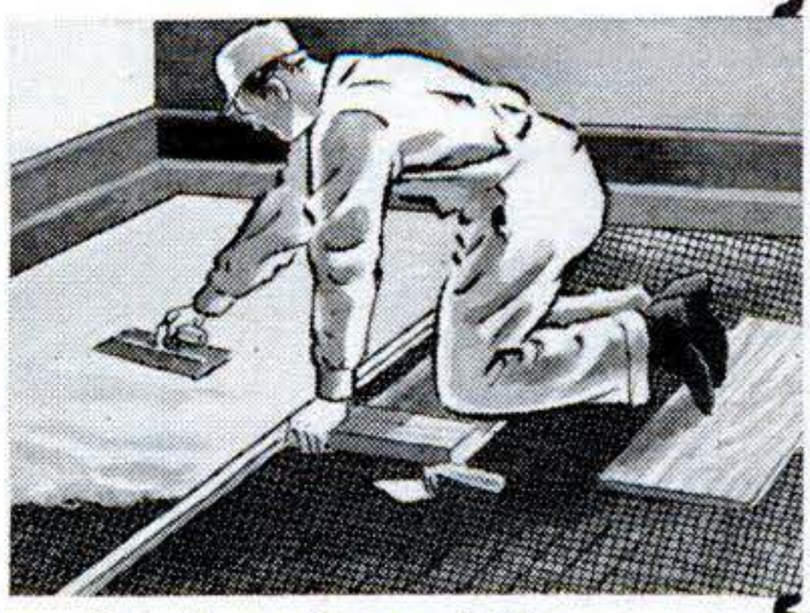

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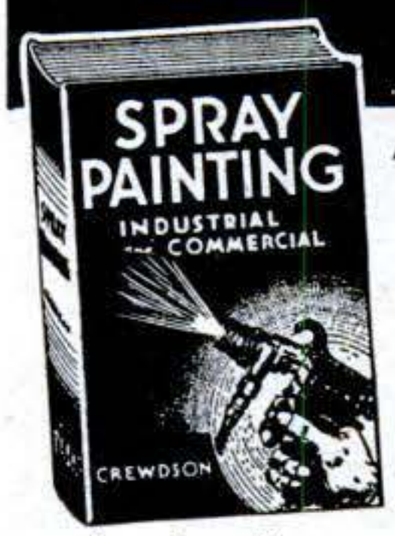

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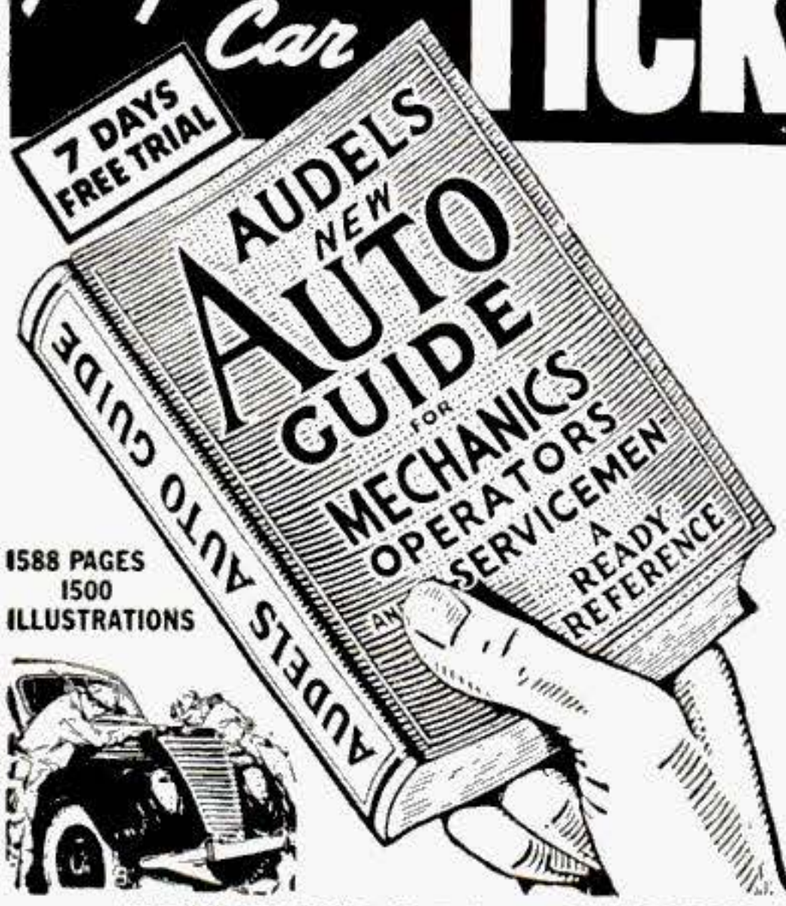

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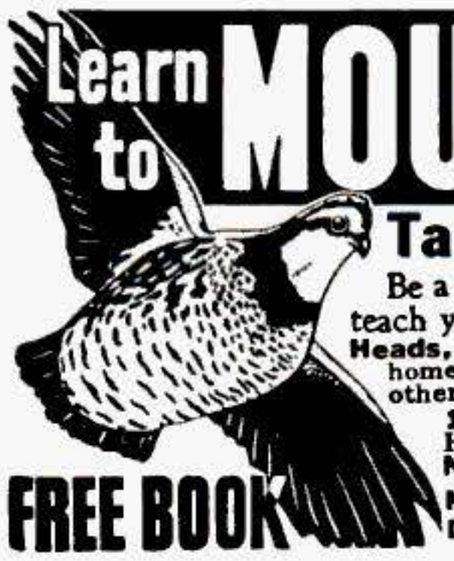

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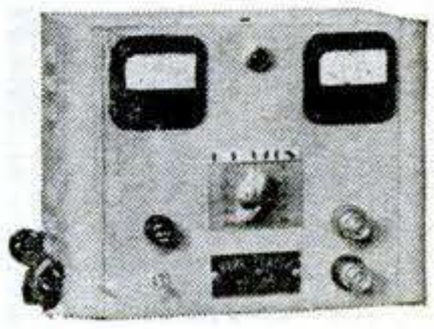

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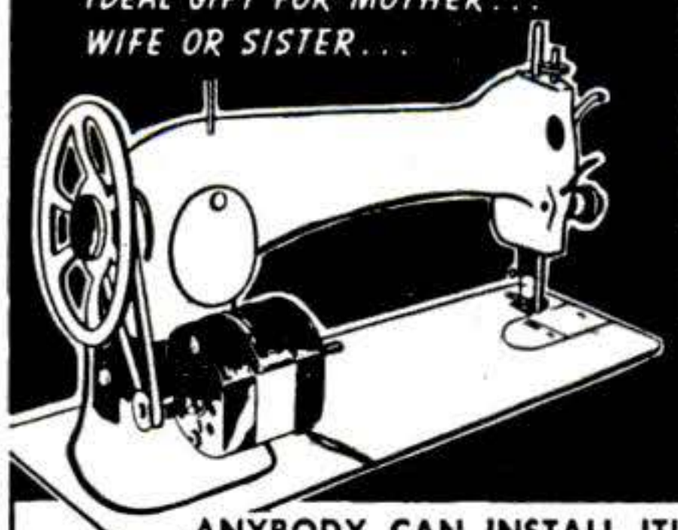

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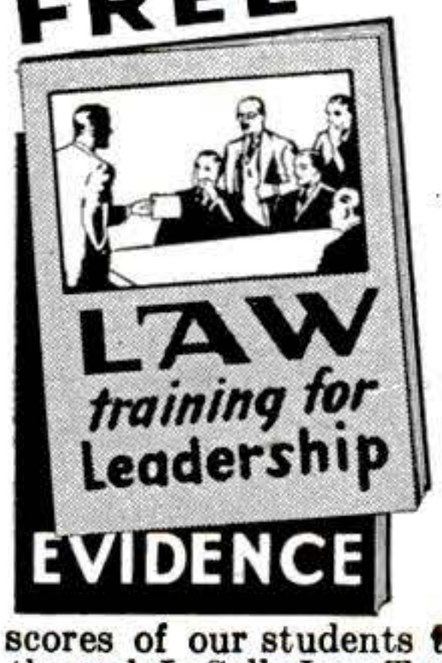

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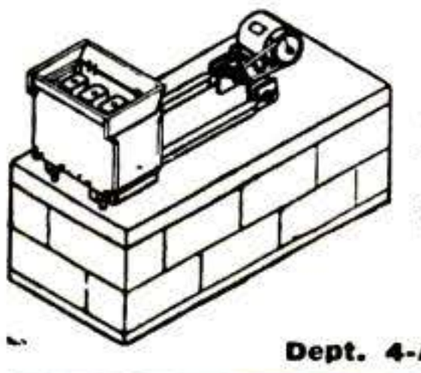

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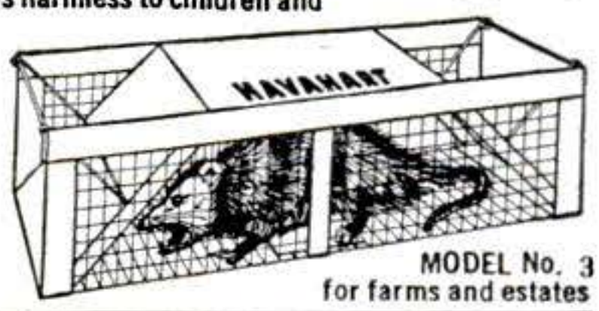

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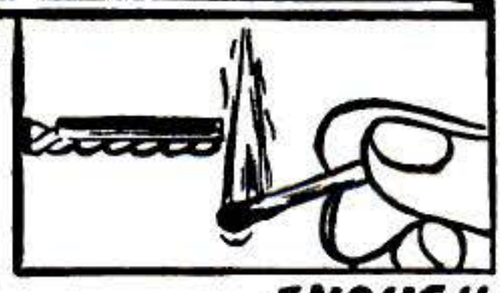

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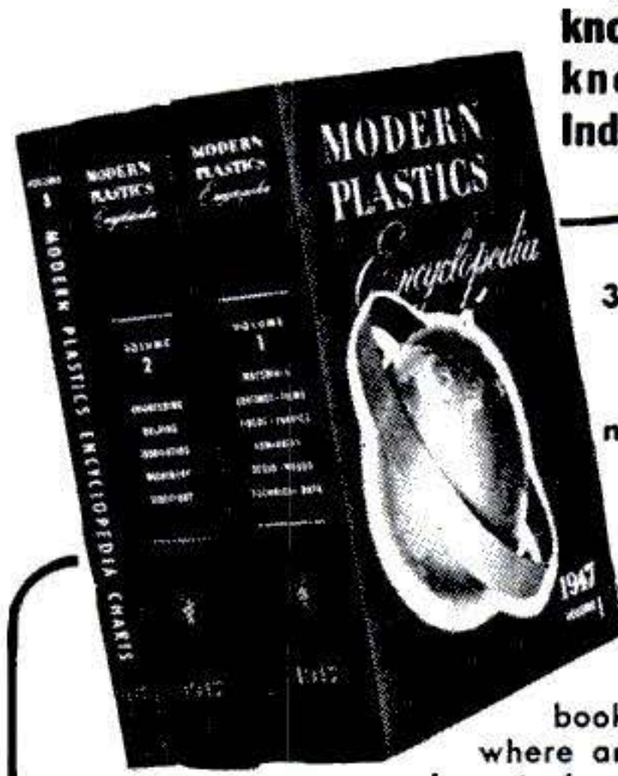

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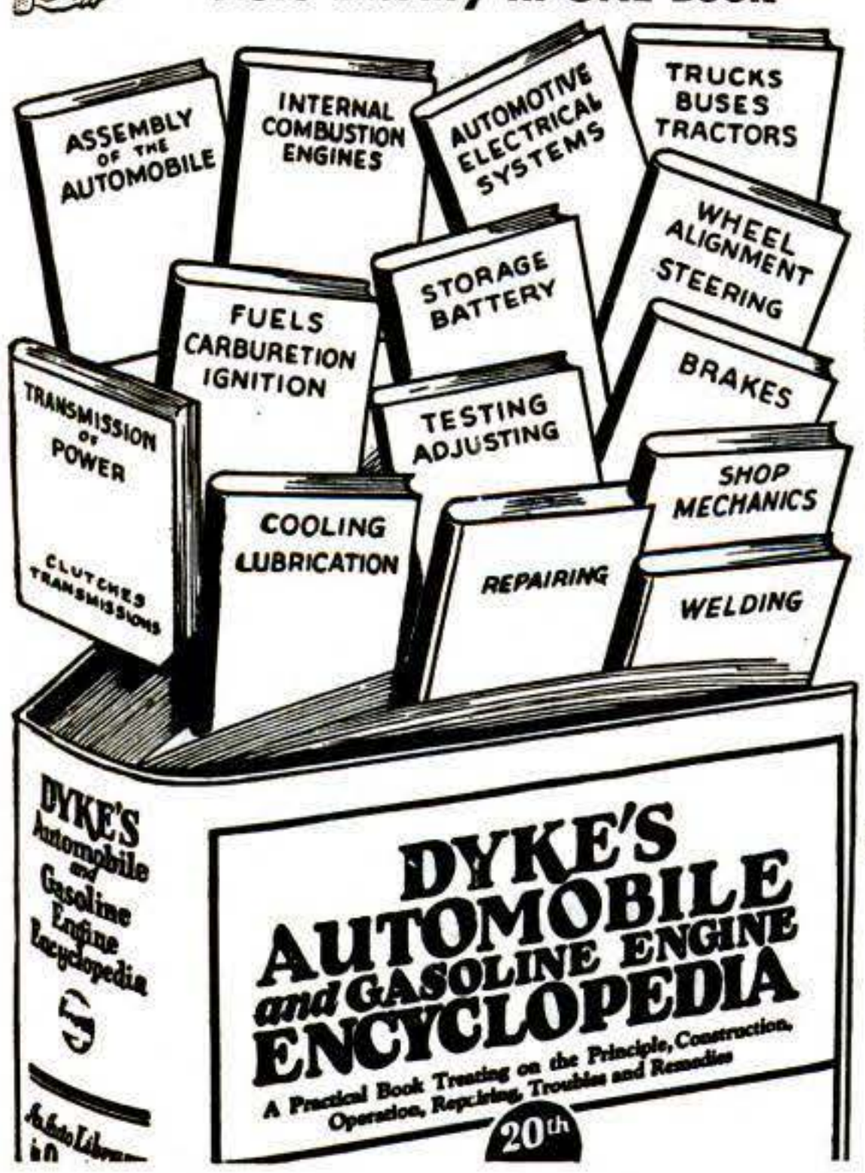

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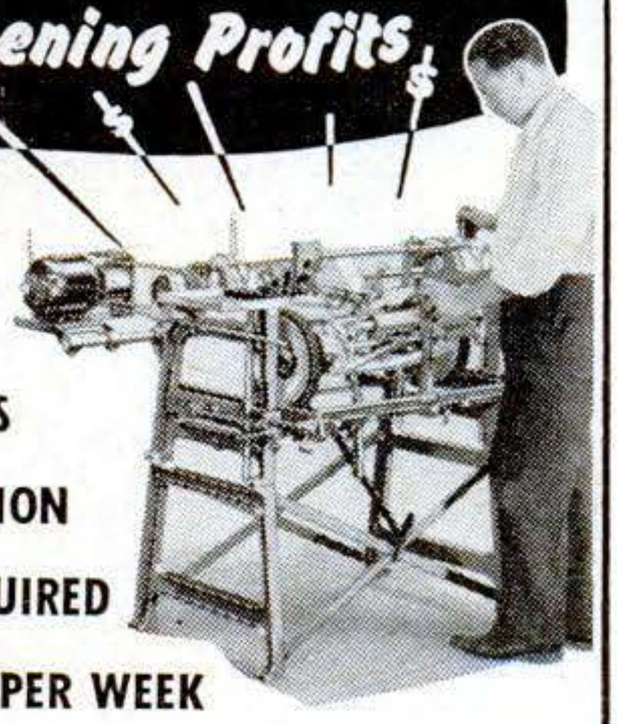

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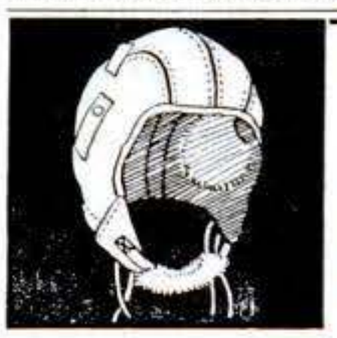

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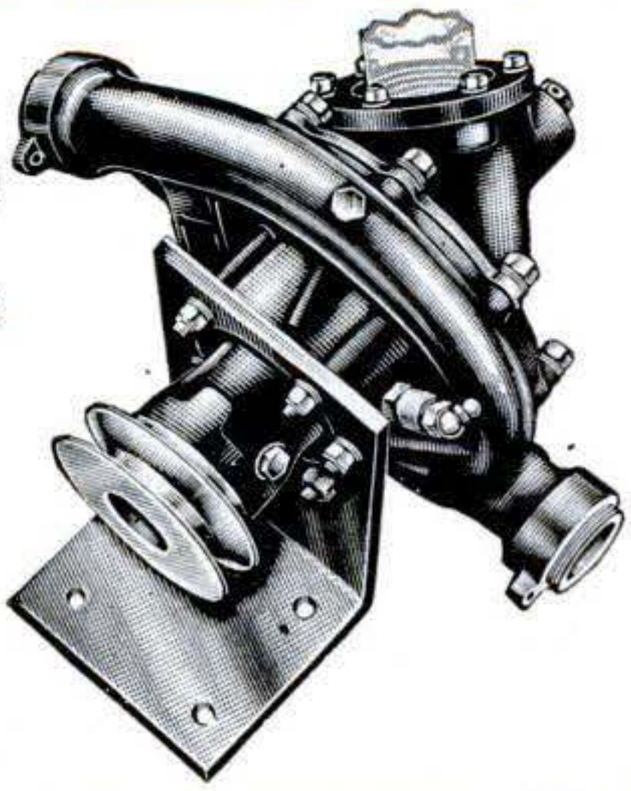

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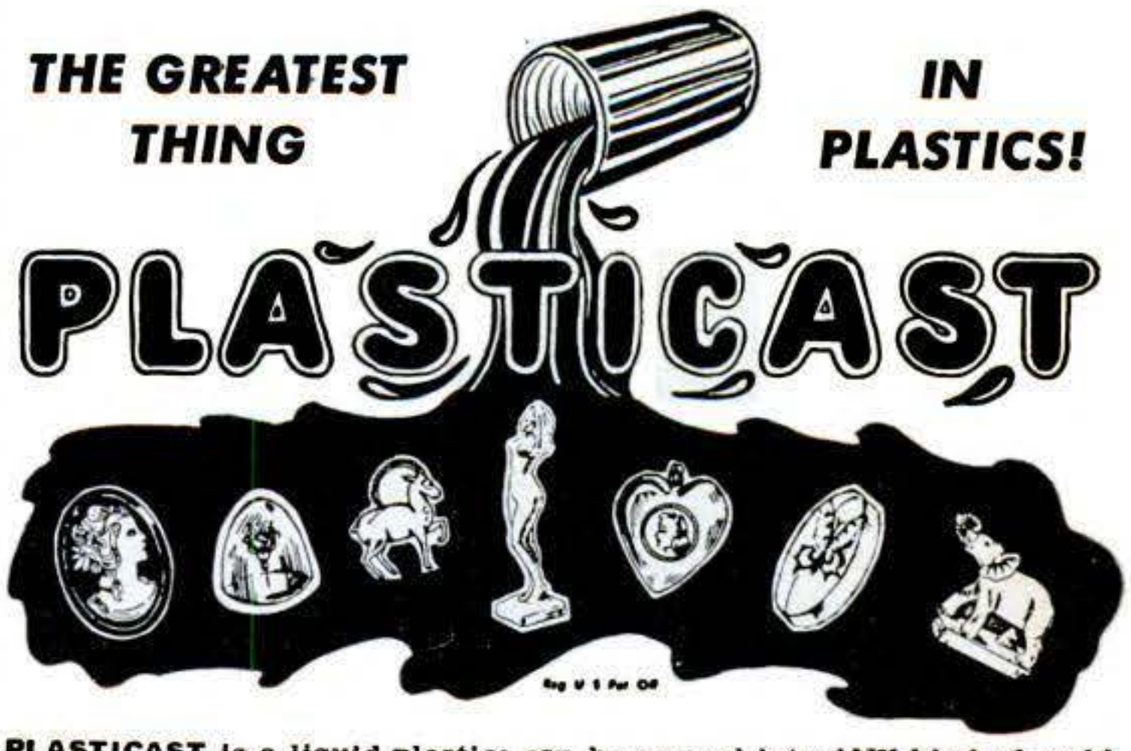

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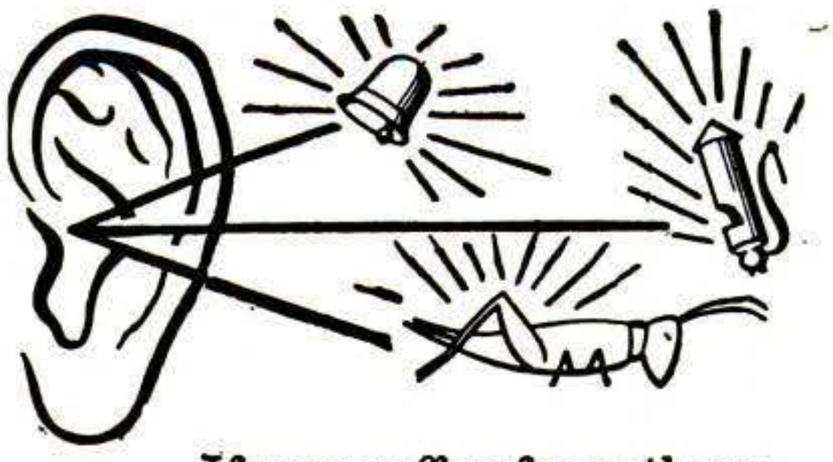

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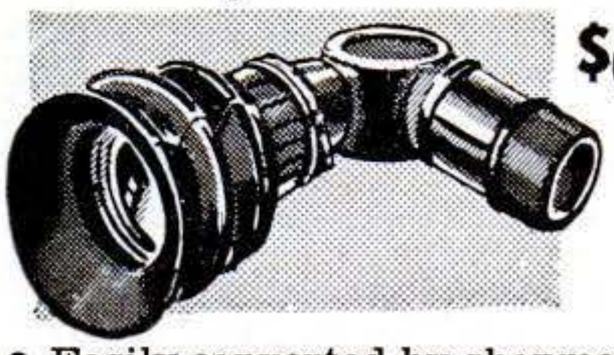

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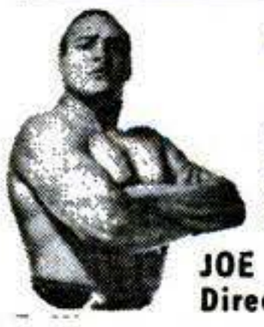

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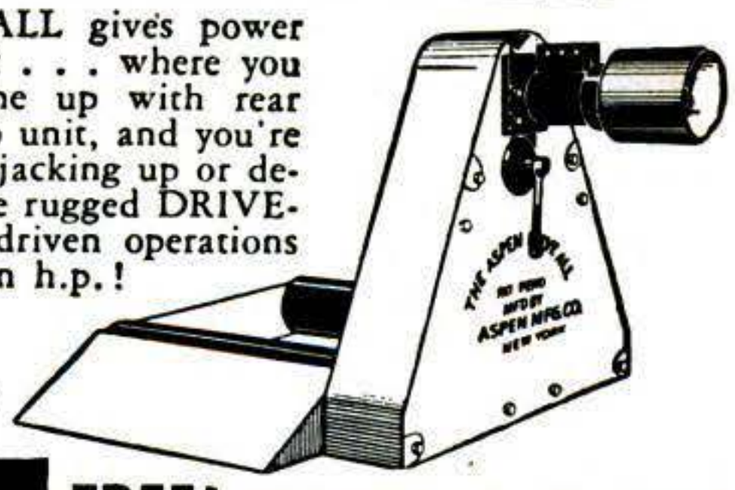

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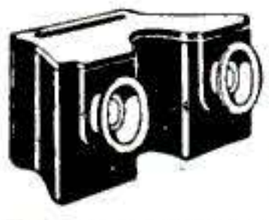

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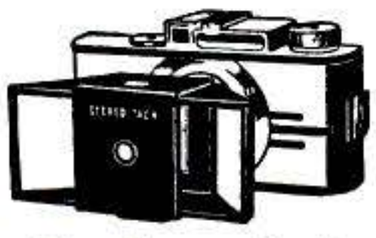

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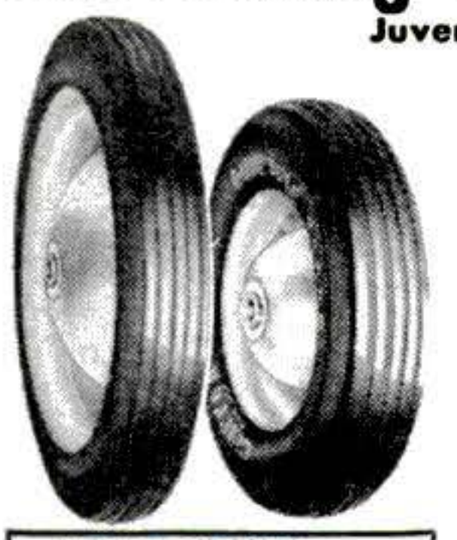

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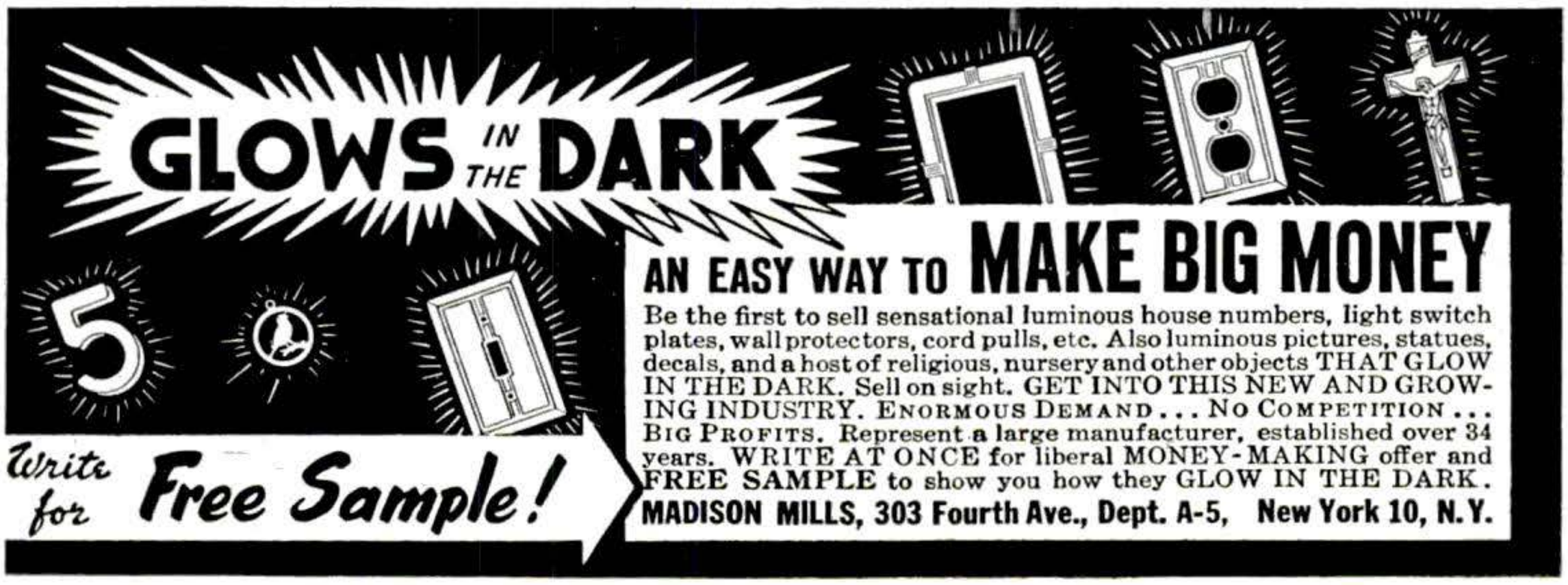

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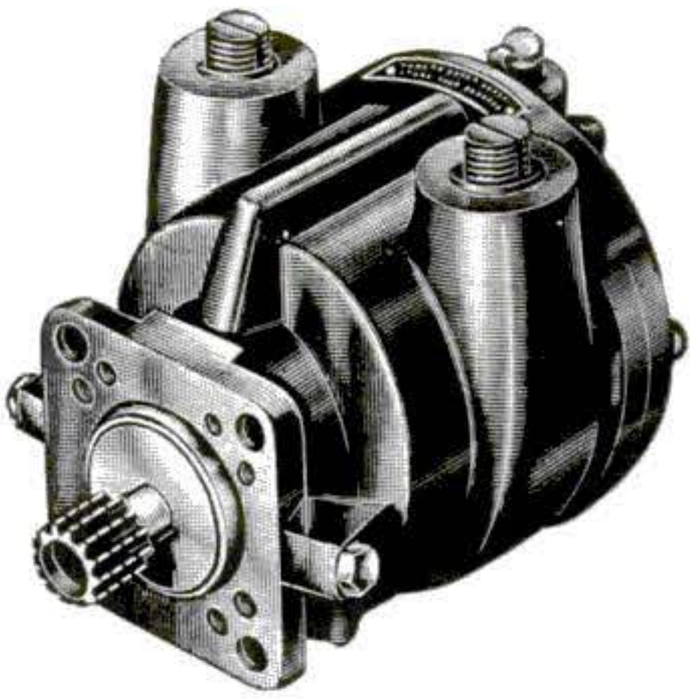

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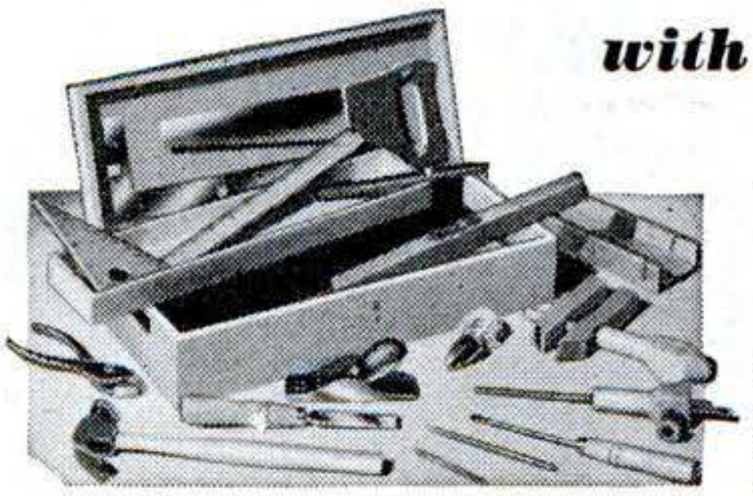

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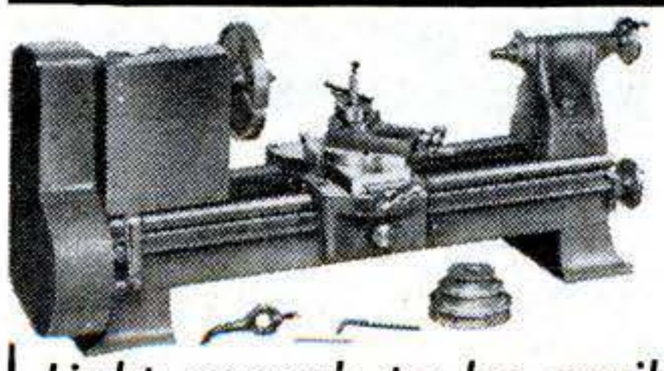

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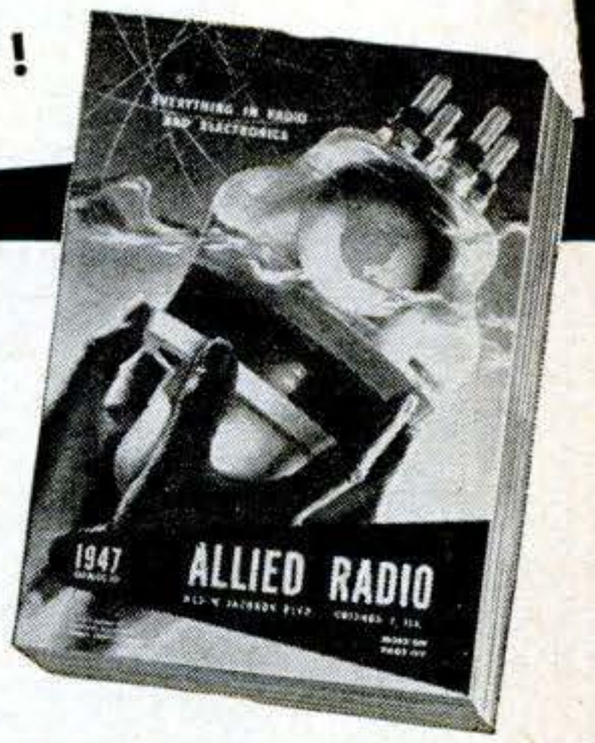

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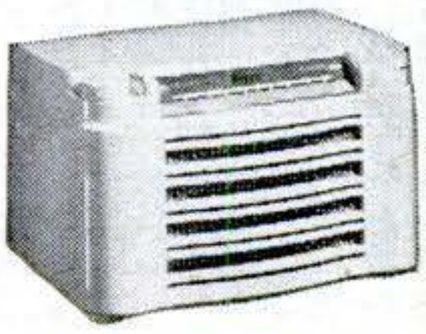

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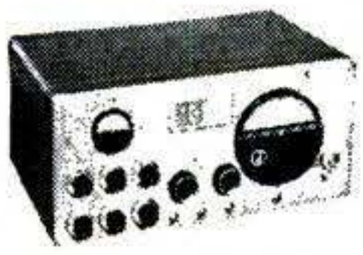

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Why try to worry along with trusses that gouge your flesh—press heavily on hips and spine—enlarge opening—fail to hold rupture? You need the Cluthe. No leg-straps or cutting belts. Automatic adjustable pad holds at real opening—follows every body movement with instant increased support in case of strain. Cannot slip whether at work or play. Light. Waterproof. Can be worn in bath. Send for amazing **FREE** book, "Advice To Ruptured," and details of liberal truthful 60-day trial offer. Also endorsements from grateful users in your neighborhood. Write:

Cluthe Sons, Dept. 14, Bloomfield, New Jersey

RADIO PARTS "Jack Pot"

$3.88
ORIGINAL VALUE OVER $25

You hit the "jack pot" in value when you get our kit of war surplus radio parts. Over $25.00 worth of merchandise for only $3.98. Think of it—over 200 parts. Transformers, coils, condensers, resistors, sockets, controls, etc. Ideal kit for the radio experimenter. Send check or M.O. today.

MARKO SURPLUS CO.
Dept. A2-R, 2924 Logan Blvd., Chicago 47, Ill.

EARN BIG MONEY BE AN ARTIST

Now you can really teach yourself to be an artist with the help of one of the leading art directors. Special simplified quick course showing all the short cuts to becoming a big time artist. Learn to draw and paint for magazines, advertisements, etc.

10 complete lessons, including actual artists' sketches and example drawings on real art board—figure drawings from live models, art poses, anatomy, cartoons, caricatures and many others.

OVER 200 ILLUSTRATIONS

Extra! For Prompt Action

5 COMPLETE ART BOOKS ON ALL SUBJECTS OF ART EVERYTHING POSTPAID

MONEY BACK GUARANTEE! Fill out coupon, enclose in envelope with TWO DOLLARS cash or money order and mail to

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P. O. Box 2344, Los Angeles 54, Calif.

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ADDRESS _____

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COMPLETE COURSE POSTPAID $2.00

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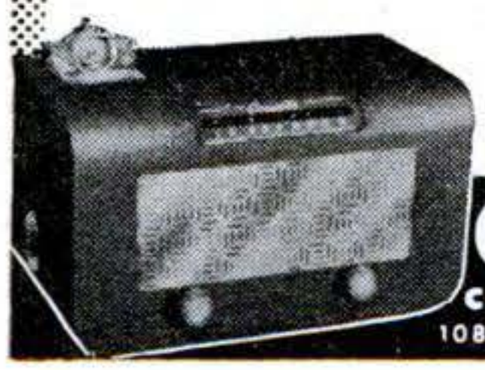
THIS IS THE BUSINESS YOU DREAM ABOUT

QUICK STEADY PROFITS

CORADIO

The Coin Operated Radio

IT'S the new, fast-growing, depression-proof business. Coin operated radios are placed in hotels, tourist courts, clubs, hospitals, etc. on a commission basis—play 1 or 2 hours for 25c and produce immediate profits. The best coin operated radio is CORADIO



ACT NOW

Start your own lifetime business, full or part time. Limited capital required.

Send for further information.

WRITE TODAY Dept. P.S.

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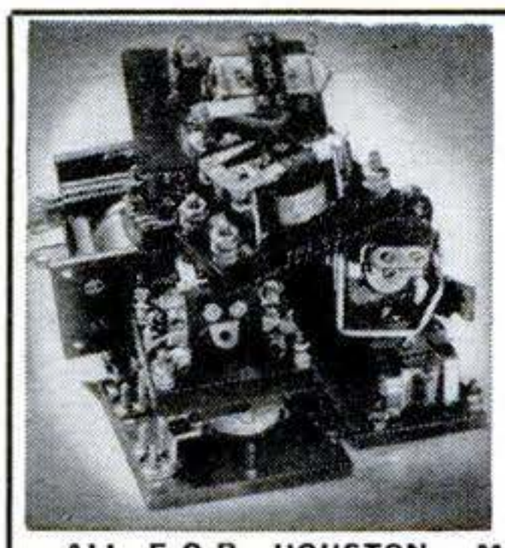
108 W. 31st ST. N.Y 1, N.Y. WISCONSIN 7-5902



Surplus Special

ELECTRIC RELAY ASSORTMENTS

No. 101—All brand new! At least 10 in assortment. Misc. types. Electricians, electronic and radio experimenters will welcome this value. All are standard make, precision units. Shp. wt. 6½ lbs.

10 ASST. RELAYS ALL FOR ONLY $5.95

ALL F.O.B. HOUSTON. MAIL ORDERS PROMPTLY FILLED. SEND CHECK OR MONEY ORDER. SATISFACTION GUARANTEED.

SOUTHWEST AERO SUPPLY Dept. PS1
P.O. DRAWER 488 SOUTH HOUSTON, TEXAS

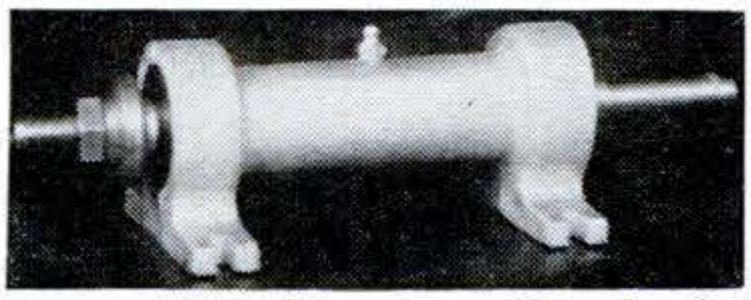
BRASS Social Security Plates

STAMPED WITH YOUR NAME AND "SS" NUMBER

Beautifully satin-finished (shown 1/3 size). Please print information clearly. Priced at only **50c** each, postage paid **50¢**

ACME STAMPING SERVICE
Box 836-PS Davenport, Iowa

Ball Bearing All Purpose Mandrell, $5.95



P.P. Anywhere in U.S.

Send Certified Check or Money Order

Length overall 11½"
Shaft size ⅝" or ½"
(Optional)

THE CARTER CO. Box 195 Lexington (73), Mass.

FREE!

Write for Dr. Brager's free 36 page booklet today.

GENUINE SURGICAL ELASTIC

"Bub" Durililknit SUPPORTER

Get new vigor—paunch flattened, "energy region" cradled, back firmed. "Bub" is guaranteed to outlast, outlaunder any 3 other supporters. Buy "Bub" at sporting goods, drug, men's wear, dept., surgical appliance stores. Or mail coupon.

JOHN B. FLAHERTY CO., INC.
614 E. 133rd St., Bronx 54, N. Y.

☐ Send Dr. Brager's free 36 page booklet.

Send waist size ....."Bub" as checked in quantities indicated. I enclose check or money order.
(NONE C.O.D.) CANADA 50c ADDITIONAL

☐.....10" waist band (illus. above) $4.50 ea.
☐..... 6" waist band $2 ea.
☐..... 4" waist band $1.50 ea.

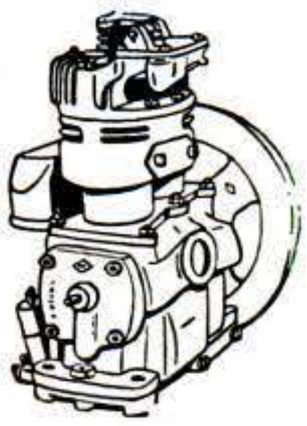
Detachable pouch in 10" model

Name (PRINT).....

Street..... City..... State.....

AIR COMPRESSORS

Bendix-Westinghouse 4 cu. ft.



2 Cylinder BUS and Truck Piston type ball bearing. Pressure feed oil system.

Positively one of the finest and most accurately built air compressors on the market. Each Compressor completely checked and in good operating condition.

For home work shop; garage, filling stations; farms; factories, etc.

Original cost $140.00.
Our price FOB, K.C. $34.50

Accessories available for compressors, includes air regulators, safety valves, air gauges, control governors, misc fittings, hose, paint guns. BIG Savings.

MIDWEST SURPLUS SALES CO. 1520 Locust St. Kansas City, Mo.

Amazing Lens

600

POWERFUL Magnifying Lenses to EVERY SQ. INCH!

Center of every letter is **clear** so light shines through. Translucent edges give "aura" effect of Neon.

Choice of Thousands of Different Glass Panels. CHANGE ADVERTISING MESSAGE IN 10 SECONDS!

Invention Makes New Advertising Sign *BRILLIANT AS NEON!*

COSTS ONLY ½ AS MUCH

AGENTS! Fast Sales In Every Kind of Retail Store. Big Profit on Every Sale!

A few years ago, men who got in on the "ground floor" with Neon, cleaned up **millions. Today,** a few wide-awake men are offered a chance to cash in on another advertising opportunity that may be even bigger—a "once-in-a-lifetime" chance to get in on the **"ground floor"** with the new Fluorescent MAXILUME Business Builder—the advertising Display Sign that can change **sales messages in 10 seconds! Here is an invention as startling, as revolutionary as Neon was 10 years ago.** For it offers all the advantages of Neon at **½ the original cost and at an operating cost of only 2c a day!**

FREE! Send Name for SAMPLE OFFER and FREE SELLING OUTFIT

Every retail store, every large manufacturer, every advertiser in the United States is a prospect for one to 100 or more Business Builders. Space does not permit printing all facts. But if you want big, quick profits in volume you never dreamed of, you'll **get** the facts in a hurry! Don't send a penny. Just your name on a penny post card brings Free Selling Outfit. Do this quick—for the biggest cash clean-up in the history of Direct Selling!

MAXILUME COMPANY, 125 W. Hubbard, Dept. 91, Chicago 10, Illinois

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20 Million Refrigerators Need Service and Repairs

REFRIGERATION Made Easy!

Biggest Opportunity In Many Years!

NEW PRINTING—ALMOST 1000 PAGES

408 Pictures—17 Diagrams In Colors Makes All Refrigerator Service Maintenance, Repairs Simple as A.B.C.

Millions of refrigerators need service and repairs. Owners are paying big for competent service which will be needed more and more as these refrigerators get older. Get MODERN GAS AND ELECTRIC REFRIGERATION, the non-technical guide to all types of refrigerators and get your share of this new profit. Get a job or start your own service business. This book will help you make money anywhere. Thousands of copies have been sold. Used by trade schools, manufacturers training programs and U. S. Army. Mail coupon. Send $5.00 or we will send C.O.D. Money back in 5 days if not satisfied. Act now—this may be the opportunity you have been waiting for.

SEND NO MONEY! Mail Coupon

GOODHEART-WILLCOX CO.,
2009 S. Michigan Ave.,
Dept. 531, Chicago 16, Ill.

Send Gas and Electric Refrigeration. ( ) $5.00 enclosed. ( ) Send C.O.D. (in U. S. or Possessions). I will return book in 5 days if not satisfactory and you will refund my money. If remittance accompanies order we will pay postage charges.

Name.....

Address.....

City.....State.....

Table Top MODEL RAILROAD!

Imagine a roaring locomotive in the palm of your hand . . . cars not much bigger than this ad . . . all exact scale models that operate electrically on 15/32" track. You can have a whole layout on a card table or desk. Equipment easy to build from kits, or may be obtained ready-to-run, including freight and passenger cars, steam and diesel engines, track, etc. See your Hobby Dealer or send dime for illustrated circular and price lists.

H. P. PRODUCTS CO., Hartford City, Indiana

PRESTO! ANYONE CAN MASTER GLAZE

Car Owners! Meet Master Glaze—the sensationally different luster for new and used cars! Not a wax—not an oil polish—not a paint!—nothing that "smears" over the surface.

MASTER GLAZE is a unique discovery—a creamy liquid—quick and easy to apply! Gives a hard, glass-like surface. Even gasoline cannot dull it! Lasts six months to a year! Amazing luster—beautiful, sparkling clean and brilliant! Doesn't finger-mark—doesn't smear! A match box full glazes an entire car. Seals the pores—protects! NOTHING LIKE IT!

AGENTS
An unusual opportunity! Quick, flashy demonstrator. Big profits. Good territory. Write today!

FREE SAMPLE

Just send your name and address to

MASTER GLAZE CO., 7720-625 W. Harwood Ave., Milwaukee, Wis.

This Easy Way TEACHES GUITAR to Your Satisfaction in 30 Days Or Money Back

Astounding new Jim Major Home Method teaches you to play guitar easily, quickly, without long hours practicing scales or exercises. *No musical knowledge necessary.* Play many popular songs, hymns in very short time. 30 lessons, complete course for only $1.69. EXTRA—BIG 53 SONG BOOK included without additional cost. Send no money . . . pay postman $1.69 plus postage. (Cash with order we pay postage.) Money back guarantee. Send today to Jim Major, Room 48-A, 230 East Ohio, Chicago 11, Ill.

SEE YOUR FAVORITE

MOVIE STARS ABOUT TOWN

8mm B&W	25 ft. . . $1.00	50 ft. . . $1.75
8mm K	25 ft. . . 2.75	50 ft. . . 5.50
16mm B&W	50 ft. . . 1.50	100 ft. . . 2.75
16mm K	50 ft. . . 7.50	100 ft. . . 15.00

HOLLYWOOD FILM ENTERPRISES, INC.
6060 Sunset Blvd. Dept. 116 Hollywood 28, Calif.

SPOTLIGHTS 6 Volt $2.95

5 Lights in One

Furnished with 4 emergency snapon lenses, Red, Amber, Green, Blue. Equipped with standard 6 volt seal beam bulb. Pistol grip trigger switch with directional swivel base—built-in toggle & pistol trigger switch **4.95**

Less swivel base **$3.95**

Less base, slightly smaller light **$2.95**

Ideal for police—fire depts., State patrol, taxicabs, ambulances, tow trucks, farm tractors, implements, boats, contractors' machinery, hunters, fishermen, campers. Other uses.

Write for descriptive circular ● No COD ● Prices FOB, Kansas City

MIDWEST BUY ANYTHING CO.
1520 Locust St. Kansas City, Mo.

STAINLESS STEEL AIR TANK WITH 100 USES

Ideal portable Air Tank to carry in car. Will completely inflate four tires from one filling.

Makes wonderful pressure tank for paint and insecticide spraying, too. Complete with air hose, air chuck, valve for filling, welded handle, and blue enamel finish.

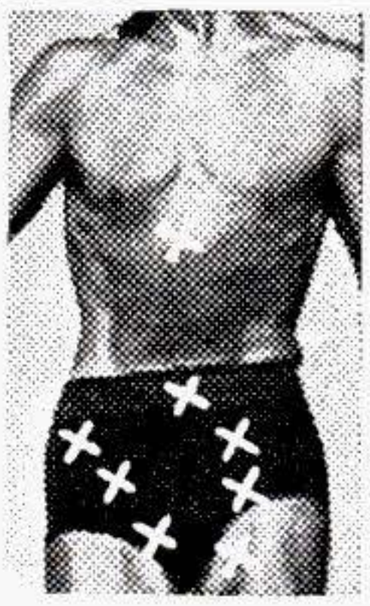
Sold in U.S. only. No foreign orders accepted.

Non-corrosive, non-shatterable. Tank tested for 450 pound pressure. Volume, 2100 cu. in. Size 12½"x24"

$7.50 F.O.B. Kansas City

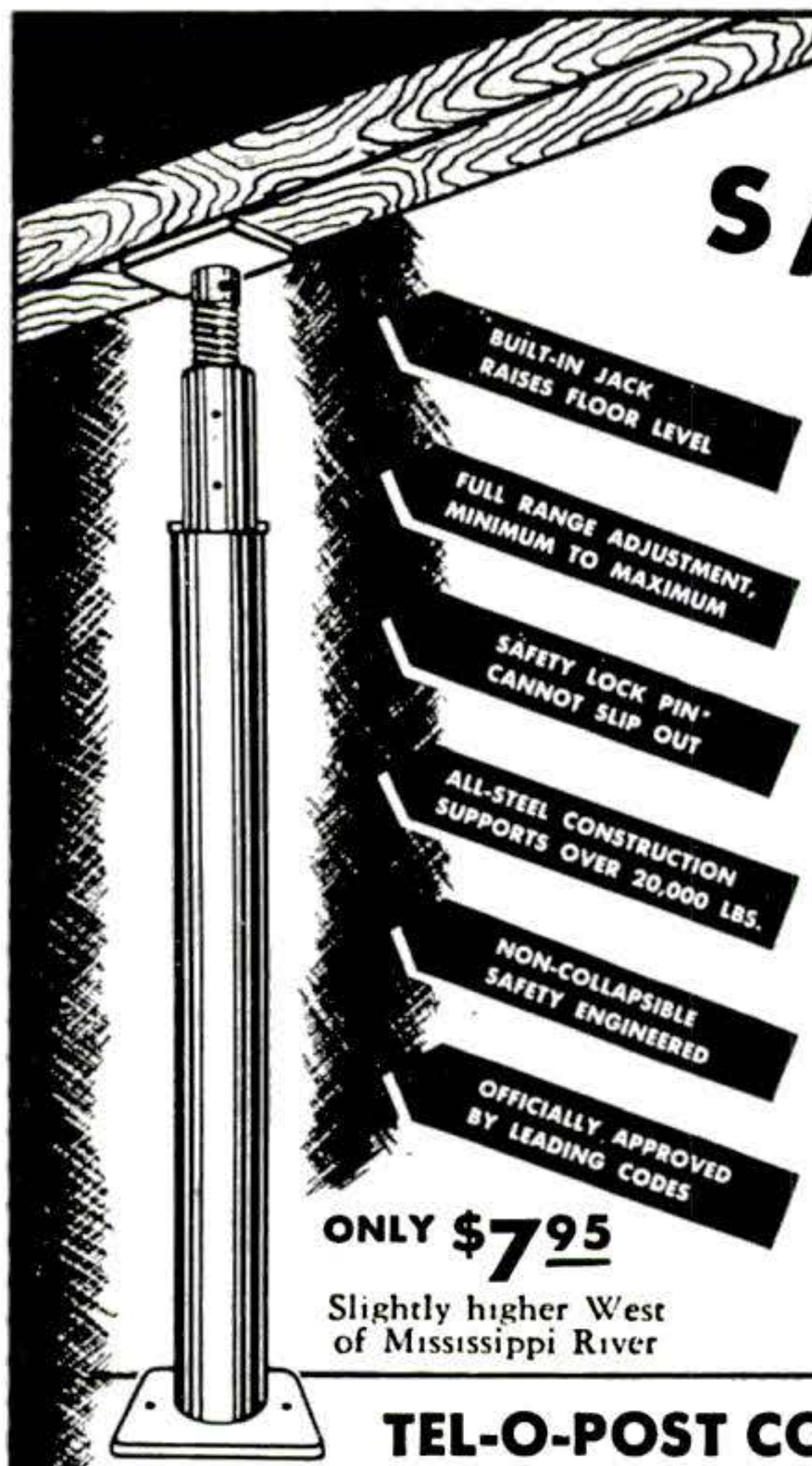
W. F. TEAGUE & COMPANY
714 CENTRAL, KANSAS CITY 6, KANSAS

LOOK for Rupture Help



Try a Brooks Patented Air Cushion appliance. This marvelous invention for most forms of reducible rupture is GUARANTEED to bring YOU heavenly comfort and security—day and night—at work and at play—or it costs you NOTHING! Thousands happy. Light, neat-fitting. No hard pads or springs. For men, women, and children. Durable, cheap. **Sent on trial** to prove it. Not sold in stores. Beware of imitations. Write for Free Book on Rupture, no-risk trial order plan, and Proof of Results. Ready for you NOW!

Brooks Company, Dept. 163B, Marshall, Mich.



LEVEL AND SUPPORT SAGGING FLOORS

Prevent Plaster Cracks—Creaky Floors—Sticky Doors and Windows

Easily and at low cost you can quickly correct sagging floor trouble in your home or in any building. Tel-O-Post jacks up sagging beams — provides permanent, safe support — stops costly home depreciation. Proved by over half a million home owners. On sale at leading building material dealers. Be sure to insist on Tel-O-Post. It's the only adjustable post that's officially approved by leading building codes.

*** Write for descriptive folder and dealer's name**

Safety Engineered

TEL-O-POST

THE ORIGINAL TELESCOPIC ADJUSTABLE ALL-STEEL BASEMENT POST

TEL-O-POST COMPANY • 140 Ash St., AKRON 8, OHIO

FIREWORKS

CHINESE FIRE CRACKERS

1 Bundle or 1280—1½" Crackers..... 4.50
1 Bundle or 1600—1½" Crackers..... 5.35

BALLOONS—LATEX RUBBER

No. K 10, per gross..... 1.50
No. K 20, per gross..... 3.00

Write Dept. R for Wholesale Quotations.
Send Remittance with Order.

UNITED FIREWORKS MFG. CO., INC.
Dayton 7, Ohio

25 PHOTO STUDIES

BY PROFESSIONAL MODELS

NOW IN FULL COLOR

No artist should be without these perfect Figure Studies of Hollywood Beauties in bright life color! On 35MM Film strip, complete with ready mounts. Order now. $10 Value for only $2.95. New series released monthly. At your dealers or write us direct.

Deluxe Magnifying Viewer
For Perfect Figure Details $1.00
(when ordered with above film.)
Viewer sold separately..... $1.50

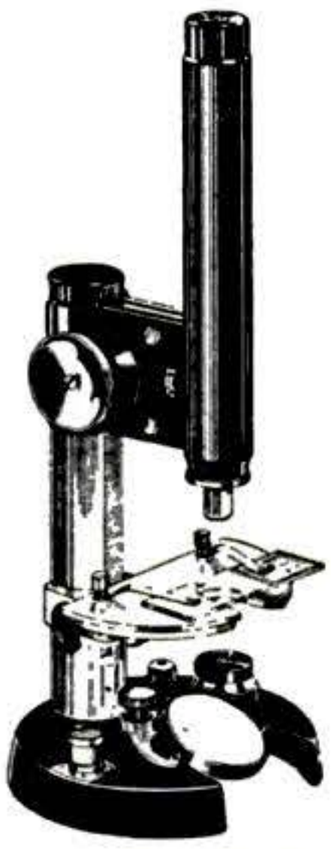
BENEFIT FILM CO. 3807 Benefit St., Balto.-24, Md.

CANVAS COVERS Waterproof tarpaulins, war surplus (Used), perfect condition. Originally made for tents. Approx. 5'x8'. Two buttoned together make approx. 80 sq. ft. Complete with buttons attached. Suitable for use as canvas dams, hay covers, truck covers, machinery and equipment covers, etc. Packed in bales 40 each, priced 40 covers, **$1.00** ea; 15 covers, **$1.50** ea. Less than 15, **$1.75** ea. All FOB, Kansas City.

AMERICAN SUPPLY CO.
329 W. 5th Dept. P. S. Kansas City, Mo.

PAN-TEK 192-POWER MICROSCOPE

$39.50



Complete with two eyepieces, separable objective, substage condenser and duplex mirror.

Fully corrected to give the four magnifications of 24X, 48X, 96X and 192X, with resolving power and size and flatness of field unsurpassed by laboratory instruments costing several times this price.

All-metal construction, finished in baked enamel, nickel and chromium.

Price, postpaid in U.S.A. $39.50
($10.00 deposit on C.O.D.'s)

Trade inquiries invited

PAN-TECHNICS, LTD.
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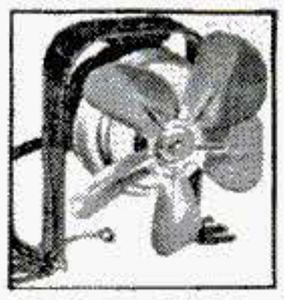

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Fractional 1/75 H.P. Delco factory tested and guaranteed long life motor. Triple rubber mountings. Noiseless operation. 2-wire rubber cord. 110V. A.C., 60 Cy. Airflow 1000 C.F.M. For cooling and ventilating purposes in Offices, Shops, Homes, also for Refrigeration Units. Blade size 7½". Stand 6¼" high, 4" wide. Complete as shown. Shipping weight 4 lbs.

No. 7014 Suction Type
No. 9272 Blower Type.....EACH, **$5.25**

Lots of 10..**EACH, $4.90** Plus postage Lots of 50..**EACH, $4.75** Plus postage

FREE CATALOG—Send for new G. & E. APPLIANCE & PARTS CATALOG.

G. & E. Equipment Supply Co.
Dept. P.S. 9, Ogden Ave. at Fulton, Chicago 7, Illinois

PROTECT FROZEN FOODS

SENSATIONAL-NEW FREEZRLARM

Here is the exclusive self-contained warning system . . . sounds an alarm whenever the temperature in your freezing unit rises above the danger zone . . . FROM ANY CAUSE! FREEZRLARM is NOT connected in any manner with the electrical system . . . it operates independently! SAVES ITS COST MANY TIMES BY WARNING BEFORE FOOD IS SPOILED. Every farm, home and locker plant needs one!

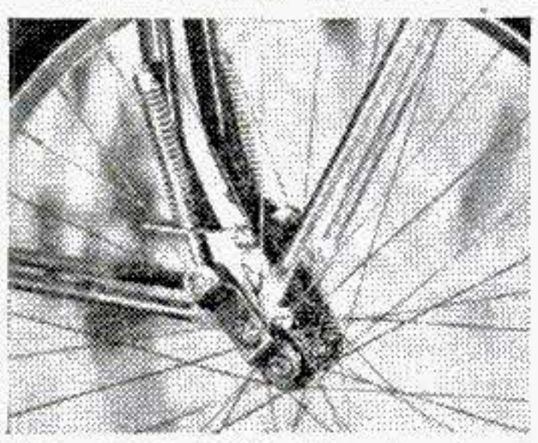
RETAIL PRICE $21.95 complete

It's small, compact, complete . . . encased in handsome walnut bakelite. Takes just a few minutes to install. No tools needed. If your dealer doesn't have it, order direct and send us his name. *Dealers: Write for our Proposition.*

FREEZRLARM CO.
832 S. Ludlow St., Dayton 2, Ohio

DO YOU RIDE A BIKE?

"SHOCKMASTER" for all Bicycles



- Levels Rough Roads
- Prevents Broken Spokes, Wheels, Forks
- Makes Riding Smoother, Safer
- Easy to Install

"Shockmaster"—the front wheel shock absorber—is ruggedly constructed of nickel plated steel and engineered for years of real service. It'll pay for itself in added pleasure, saves tires and eliminates many costly repair bills. 20,000 satisfied users. Order yours today. Only $3.69 postpaid. No C.O.D.'s. Complete satisfaction or money back. Dealers Wanted.

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THE SPEED OF SOUND

. . . but as fast as the U.S. Mail! . . . that's MOHAVE'S pace bringing to YOU the finest drafting & surveying instruments, to fit your budget, for DRAFTSMEN, ENGINEERS, ARCHITECTS and STUDENTS.

Look for MOHAVE'S trademark for accuracy & money-back guarantee. For tops in drafting, surveying & optical instruments, mineralogy equipment, slide rules & fine drafting supplies, you **cannot** afford to miss MOHAVE'S **free** Spring Bargain Sheets.

Professional supplies need cost no more than amateur quality & are sold on liberal terms if your credit warrants. Generous discounts to schools & quantity users. Surveying instruments bought for cash. WRITE TODAY!

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"EVERYTHING FOR GEOLOGISTS & ENGINEERS"
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POWERFUL AIR PISTOL

Precision made "Sportsman Jr." is Safe, Accurate. Heavy; balanced like real automatic. Shoots B-B's, Darts, Pellets. Lots of fun for indoor target practice. With adaptors, ammunition, packed in attractive gift box. Send $3.95 Check or Money Order. Postpaid.

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FOR CRAFTSMAN, CARVER, SCULPTOR

Sculpstone

With the beauty of jade and workability of wood, Sculpstone appeals to hobbyist and artist alike.

No special tools are required. Sculpstone can be cut with a knife, filed, drilled, sandpapered, or turned on a lathe.

Sculpstone is mined in Egypt and the Far East and closely resembles jade. Its color ranges from white to black, blue to green, and pink to red. Send $1.00 for Introductory Kit and price list. Special Xmas Hobby Kit sent for $5.00. Large sizes and crude stone available. Postpaid: No C.O.D.

SCULPSTONE INC. 178 Suffolk St. New York 2, N.Y.

I'd like to show you how I sold my INVENTIONS

Write for Valuable Free Booklet
GEORGE PEARCE
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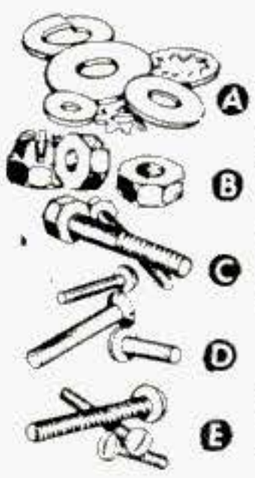
HOIST—WINCHES

New 1¼ ton capacity. Built for loading bombs into airplanes. Small, light weight, only 16 lbs., with approximately 20 ft. of Aircraft cable and 3 speed handle. Gives you 3 different gear ratios. Suitable for truck loaders, garages, industrial plants, etc. **$12.95**

FOB, K. C., Mo.—Send check or M. O.

MIDWEST BUY ANYTHING CO. 1520 Locust St. Kansas City, Mo.

HOME WORKSHOP ASSORTMENT HARDWARE KITS



Each Kit contains 2 lbs. of brand new, finest quality hardware, assorted standard sizes. All steel items cadmium plated.

(A) WASHER ASST. Flat, lock, assorted sizes.
(B) NUT ASST. Hex, castle, mach. screw, stop.
(C) Nickle steel bolt Asst. Stand. sizes, cadmium pl.
(D) RIVET ASST. Aluminum, iron, brass.
(E) MACH. SCREW ASST. All hds. standard thds.

2 Lbs. 99¢

Check or Cash with Order

"KITS" Box 298 Benton Harbor, Mich.

STOPS FOGGY WINDSHIELDS

NEW Chemical Mitt

Amazing Discovery! Autoists wild over new "NO-FOG" Windshield Cleaner. Simply glide over windshield chemically-treated Mitt—at once glass sparkles crystal clear. Cloudy haze, mist, dust, grime disappear like magic. Stops fogging. *Sells like wild!*

SAMPLES FOR AGENTS Sample offer sent immediately to all who send name at once. A penny postal will do. SEND NO MONEY—*just your name.* **KRISTEE CO., 697 Bar Street, AKRON, OHIO**

$9.95 TAKES ALL THREE BIG BARGAINS

1. AUDIO AMPLIFIER. Undreamed of value. Uses 6V6's. Has 4 microphone inputs brought to jacks at rear panel. Various output impedances available at rear panel connections. Steel case with chrome handles. 9" long x 9" high x 6" deep. Tubes included. New in original carton. Shipping weight 15 lb. SUPER SPECIAL—$4.95 while supply lasts.

2. RADIO HEADSETS. Latest supersensitive type with rubber earpieces. Every pair guaranteed perfect. $.59 per pair OR 3 PAIRS FOR $1.00.

3. HOME WORKSHOP AT BARGAIN PRICE. Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

ORDER NOW—DON'T DELAY—NO C.O.D.s

BUFFALO RADIO SUPPLY 219 Genesee St. Buffalo 3, N. Y.

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Extraordinary and unusual 8-16mm. Silent and Sound Films to thrill your Home Movie Audiences.

For Sample Film and Special List send only 10c to...

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ACCORDION
"THE PAGANI WAY"
WRITE FOR DESCRIPTIVE CIRCULAR

O. PAGANI & BRO., INC. 289 Bleecker Street New York 14, N. Y. Dept. S

HOW to Make ART OBJECTS with RUBBER MOLDS

NOW READY FOR FIRST TIME
Natural Rubber Latex
FOR BETTER MOLDS

NEW MOLDING MANUAL 10¢

MOLD MAKERS: Now for the first time since the war, you can get superior natural rubber molding compound at new low prices. Natural Rubber gives you best physical properties; 70% concentration, high elasticity, freedom from permanent set, unusual elongation. Use FRANCIS Natural Rubber Red Latex to make longer-lasting molds. At our reduced prices you can produce more and better casts per mold, at lower cost. New Illustrated Instruction Manual, showing how to mold and produce valuable novelties, gifts, accessories, mailed for only 10c (stamps or coin). Price list free.
Francis Supply Company, Dept. A-3, 1836 East Fulton St., Columbus 9, Ohio.

Carries the Same 90 DAY GUARANTEE As a New Motor Assy.

Our Finest Precision REBUILT
MOTOR BLOCK ASSEMBLIES

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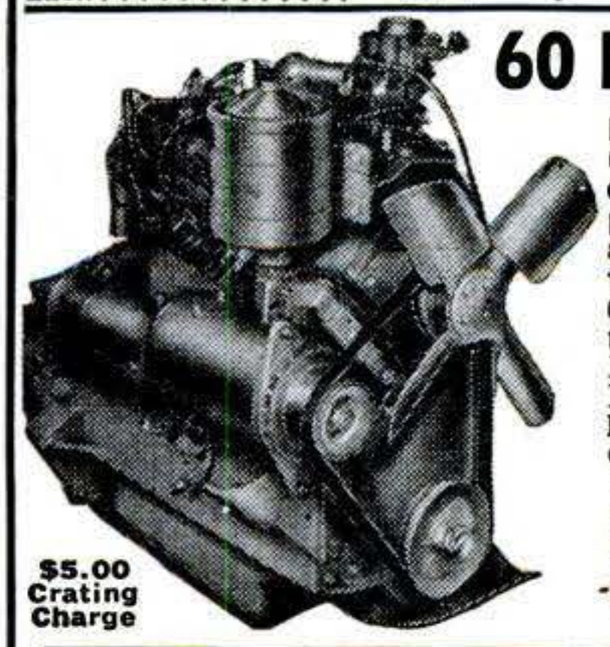

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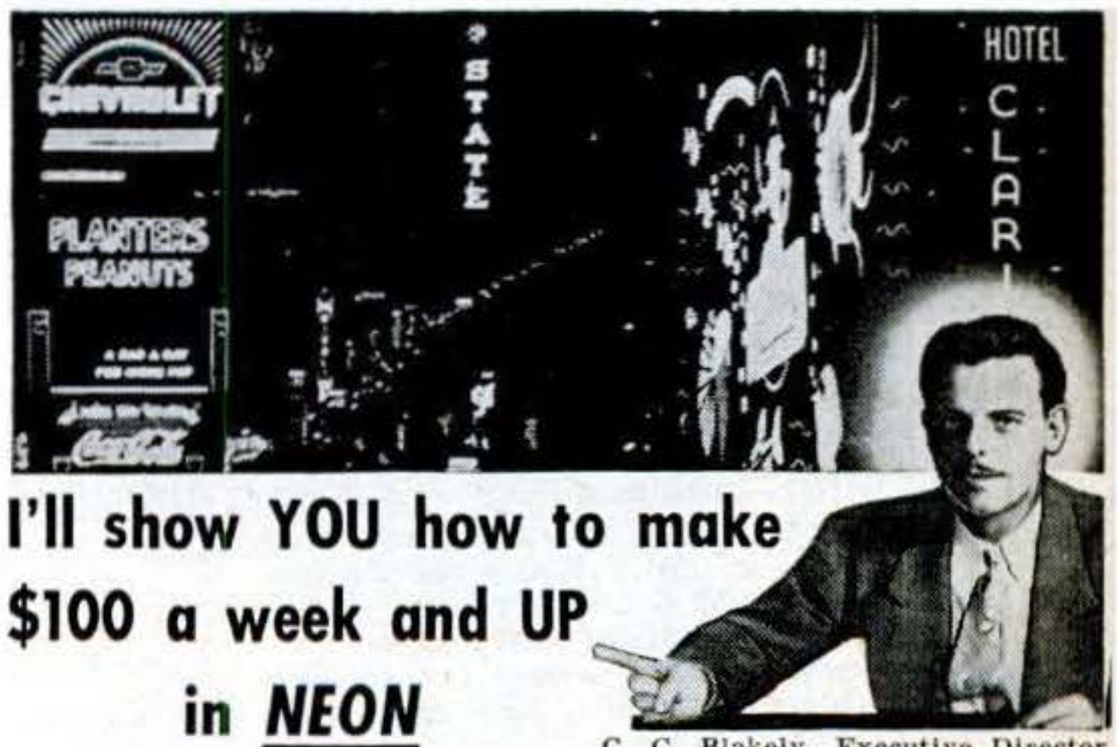

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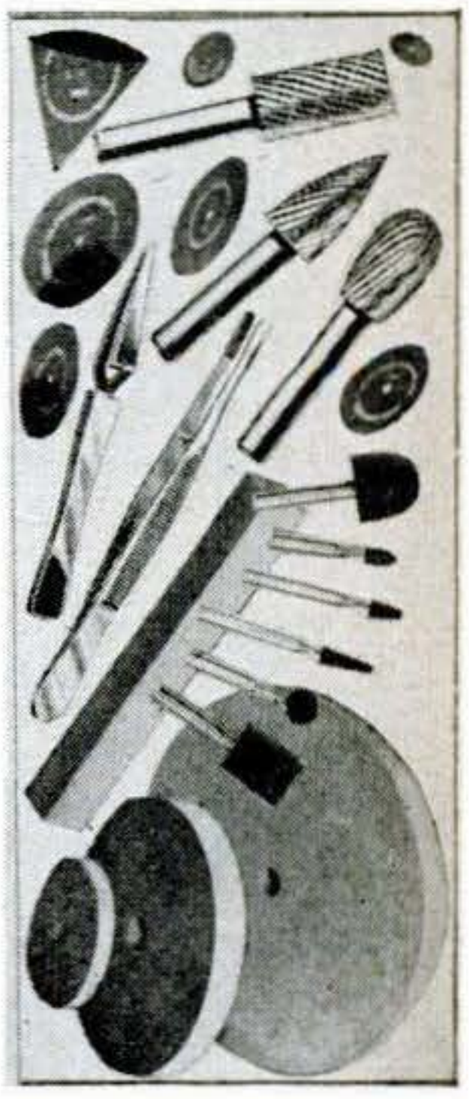

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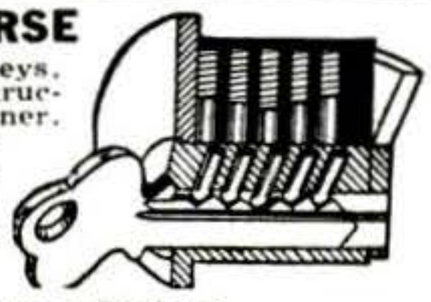

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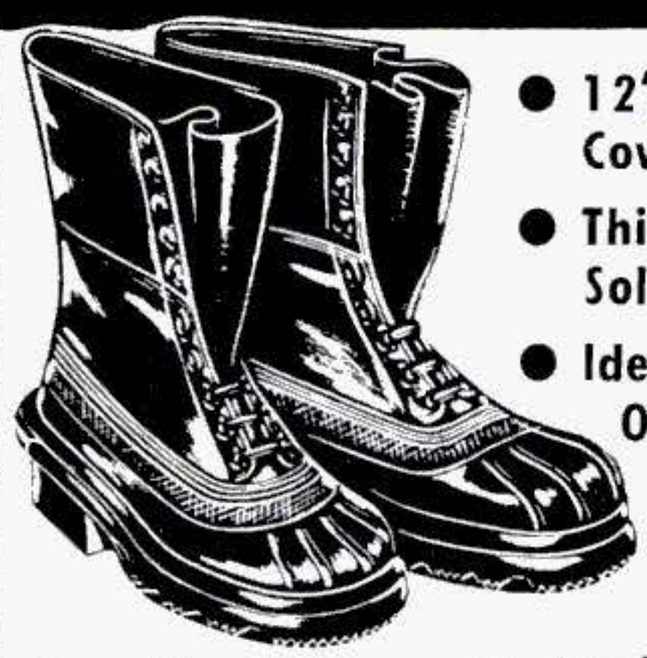

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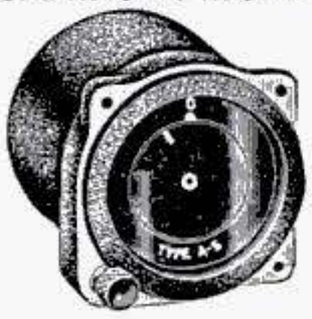

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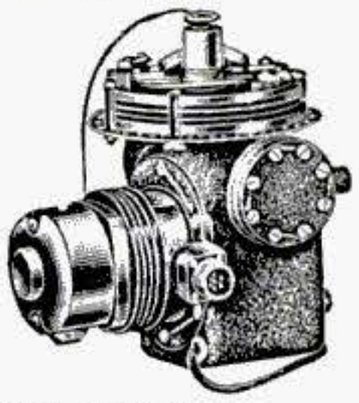

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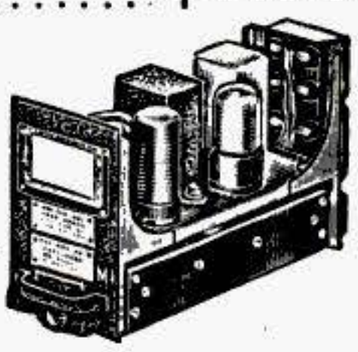

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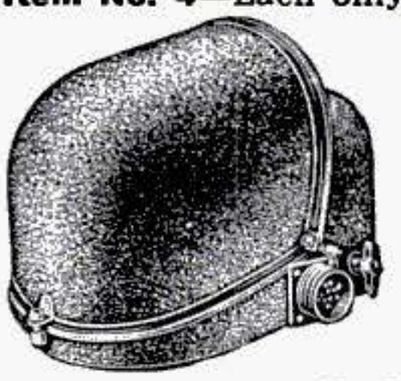

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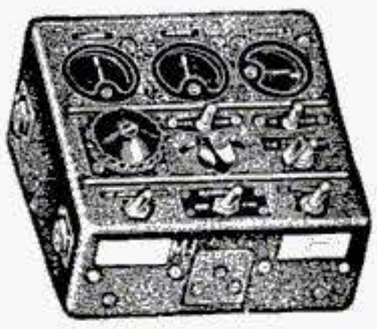

Made by Sperry. Designed to provide electronic control for the various units of the auto pilot. Measures 7½ x 8 x 4½ inches. Includes 6 toggle switches, 2 three-way switches, 3 dial indicators, plugs, resistors, etc. Parts alone are worth many times this low price. Shp. wgt. 8 pounds. **Item No. 6**— Each..... **$3.95**

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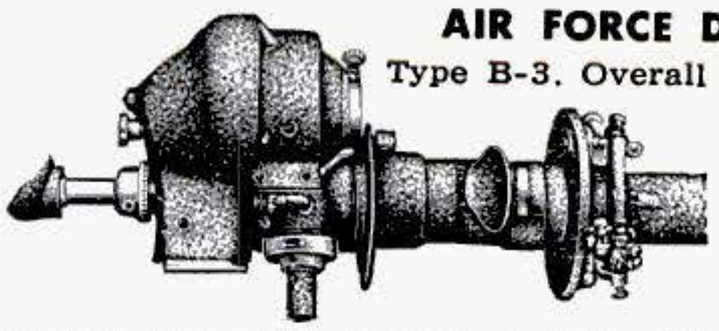

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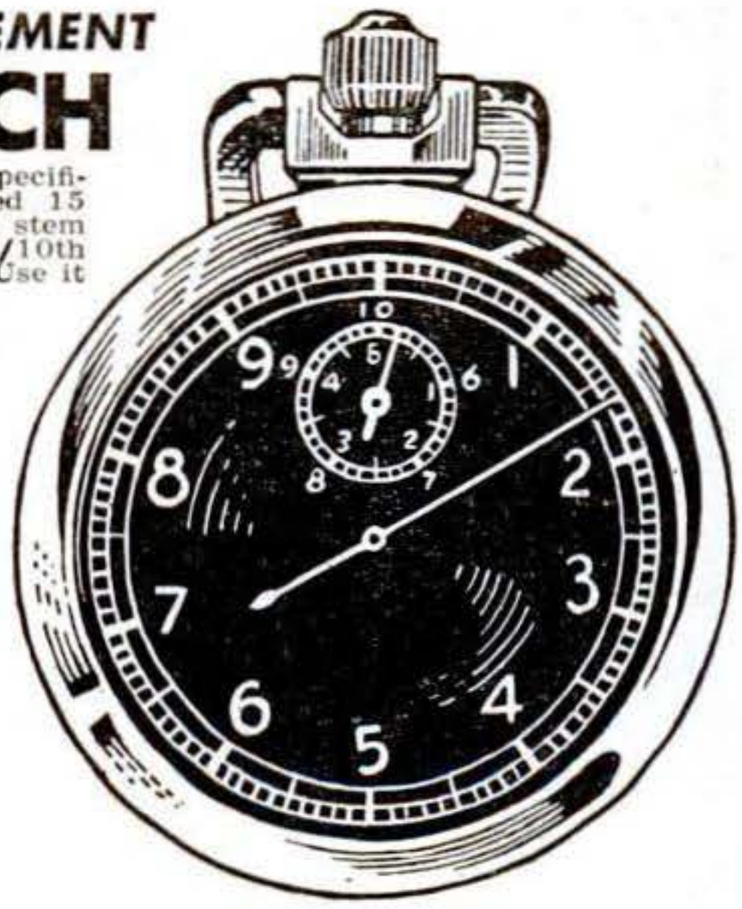

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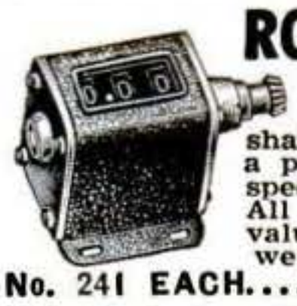

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COPPER, Brass for tooling—supplies and tools. Catalog free. Kit Kraft, 3203 W. Washington Blvd., Los Angeles 16, Calif.

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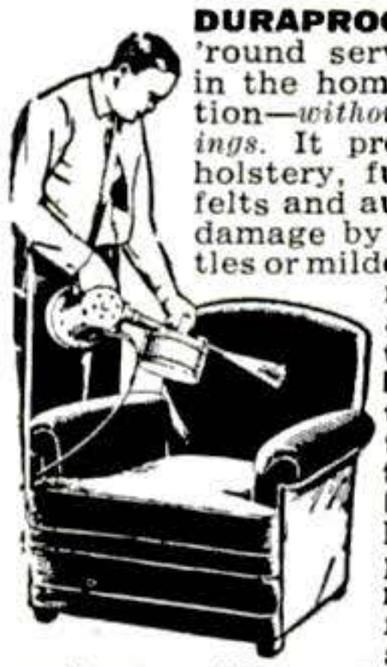

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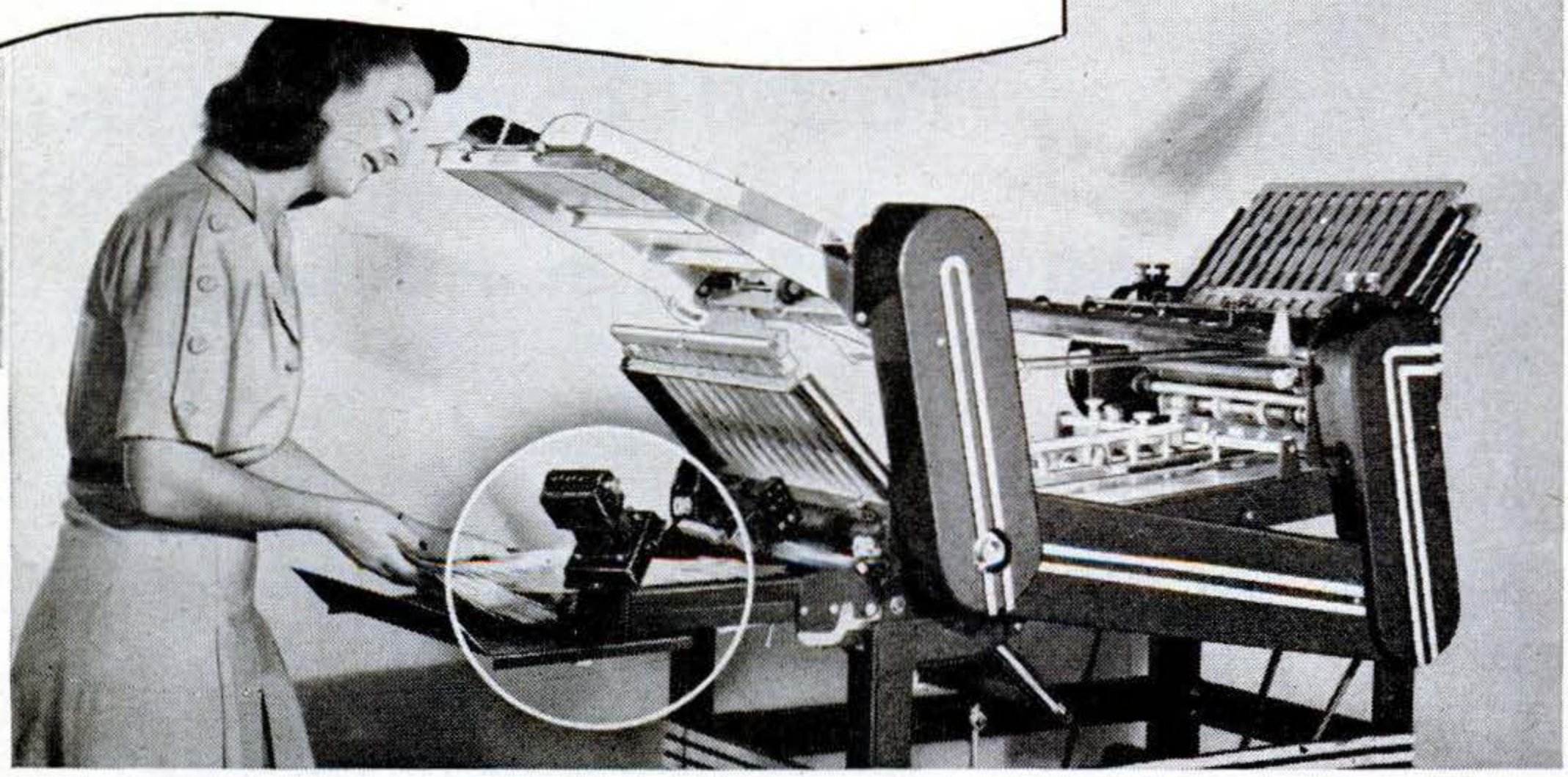

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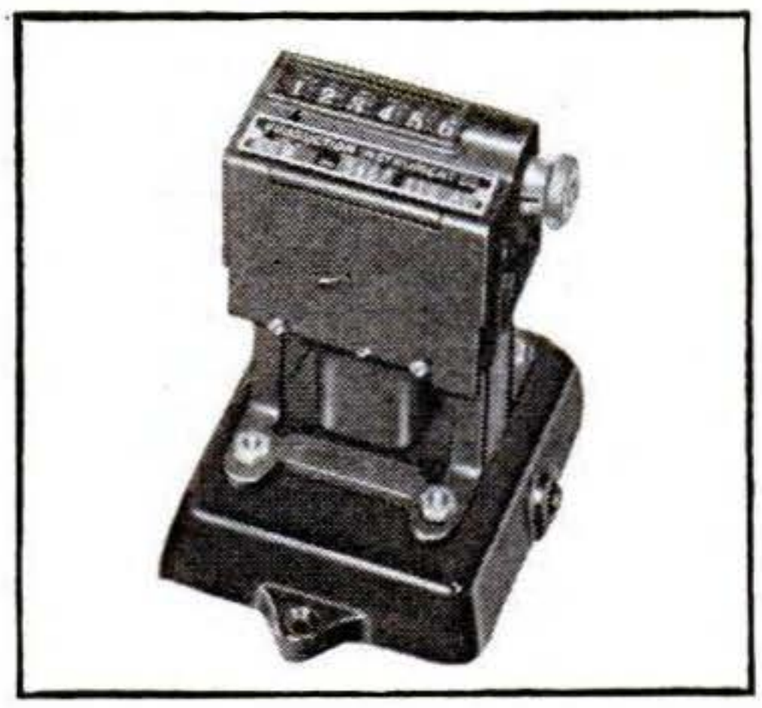

The Wizard Electric Counter

AC-54

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Had Any Acetylsalicylic Acid Lately?

OF COURSE you have—if you've had a headache or a cold. It's only aspirin! And, undoubtedly, you have sprinkled sodium chloride on your eggs and spooned sucrose into your coffee. Unless, that is, you don't take salt or sugar.

Yes, the big words of science really are a mouthful—because they say a mouthful. Most of them aren't words at all. They're whole sentences run together like Indian names. You know: "Rain-in-the-Face," or "Man-Who-Walks-Like-a-Wolf."

Scientists need such words to get across exactly what they mean. Actually, they're no worse than a mechanic saying "Hand me a twistdrillfifteenthirtysecondsinches." Or a sheet-metal worker asking for "24ST 15 gauge." Which is shorthand for aluminum sheet of a definite thickness and a definite chemical content, made in a definite way.

Chemical names, particularly, are apt to be long because they tell not only what a compound is, but what it is made from, and, sometimes, how it is made or who discovered it.

Some scientific words get shortened into trade or nicknames—like "aspirin." Today, we all know what aspirin is in terms of what we use it for. Yet even a doctor or a chemist wouldn't have known what you were talking about before 1899.

This scientific slang can sometimes be translated into plain talk. Like "polymerization" which simply means "making big ones out of little ones." Comes from the Greek words *poly,* meaning "many" and *meros,* meaning "part." To make out of many parts, that's all.

But much scientific language simply cannot be put into "plain English"—or plain anything. Any more than you can put a tune into words. You have to write it in code as music. Scientists have to use a code, too, including symbols that go beyond words.

Here's a solid chunk of science talk*,

$$\int_0^{\frac{\pi}{2}} (1-\sin^2\theta\sin^2\phi)^{\pm\frac{1}{2}}\,d\phi$$

which would take many pages to unwrap—plus several years of education in physics and mathematics to understand.

So what do you do about it? Well, if you're like me you skip it and *concentrate on what the product or process does or means.* After all, you don't need to be a chemist to take a little acetylsalicylic acid when you've got a headache.

Perry Gilbreath

*Formula is used for calculating the length of arc of ellipses, action of pendulums, and motions of projectiles.

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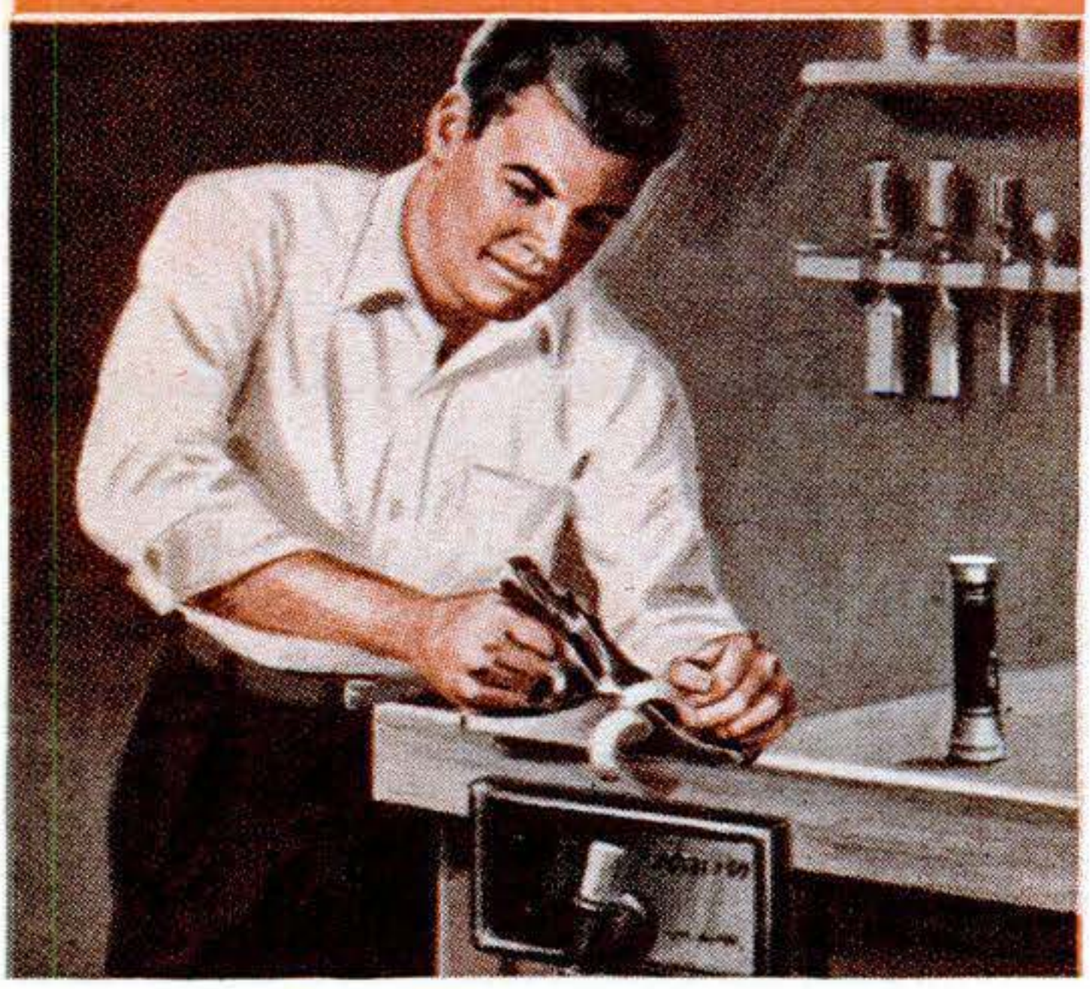
HOW TO TEST for a TRUE EDGE

A simple trick to help you "do it better"

● You've planed a board till it's slick and flat as a pane of glass . . . or at least you *think* so. "Now," you say to yourself, "I'll have a true edge for a perfect joint."

Well . . . maybe you will. And maybe you won't. But here is one way to be absolutely certain.

1 Place the planed edge on a surface you *know* to be absolutely straight — a straightedge if available. Then take your flashlight, powered with "Eveready" batteries (they outlast all other brands*), and . . .



2 . . . let the penetrating light from the flashlight play along behind board's edge. If joint *is* tight, *is* perfect, light won't get through. If there's an irregularity, light will come through. Simple, isn't it? And 100% sure!

Proof! . . . in the laboratory . . . in your own flashlight . . .

"EVEREADY" BATTERIES OUTLAST ALL OTHER BRANDS!*

Brighter light, longer life! That's what you want in a flashlight battery. And that's what you get with "Eveready" brand batteries. Laboratory tests prove it. And the best "laboratory" of all—*your own flashlight*—proves it! That's why "Eveready" batteries *outsell* all other brands—because they *outlast* all other brands!*

******According to the "General-Purpose 4-Ohm Intermittent Test" of the American Standards Association, which most closely approximates average use.*

The registered trade-mark "Eveready" distinguishes products of
NATIONAL CARBON COMPANY, INC.
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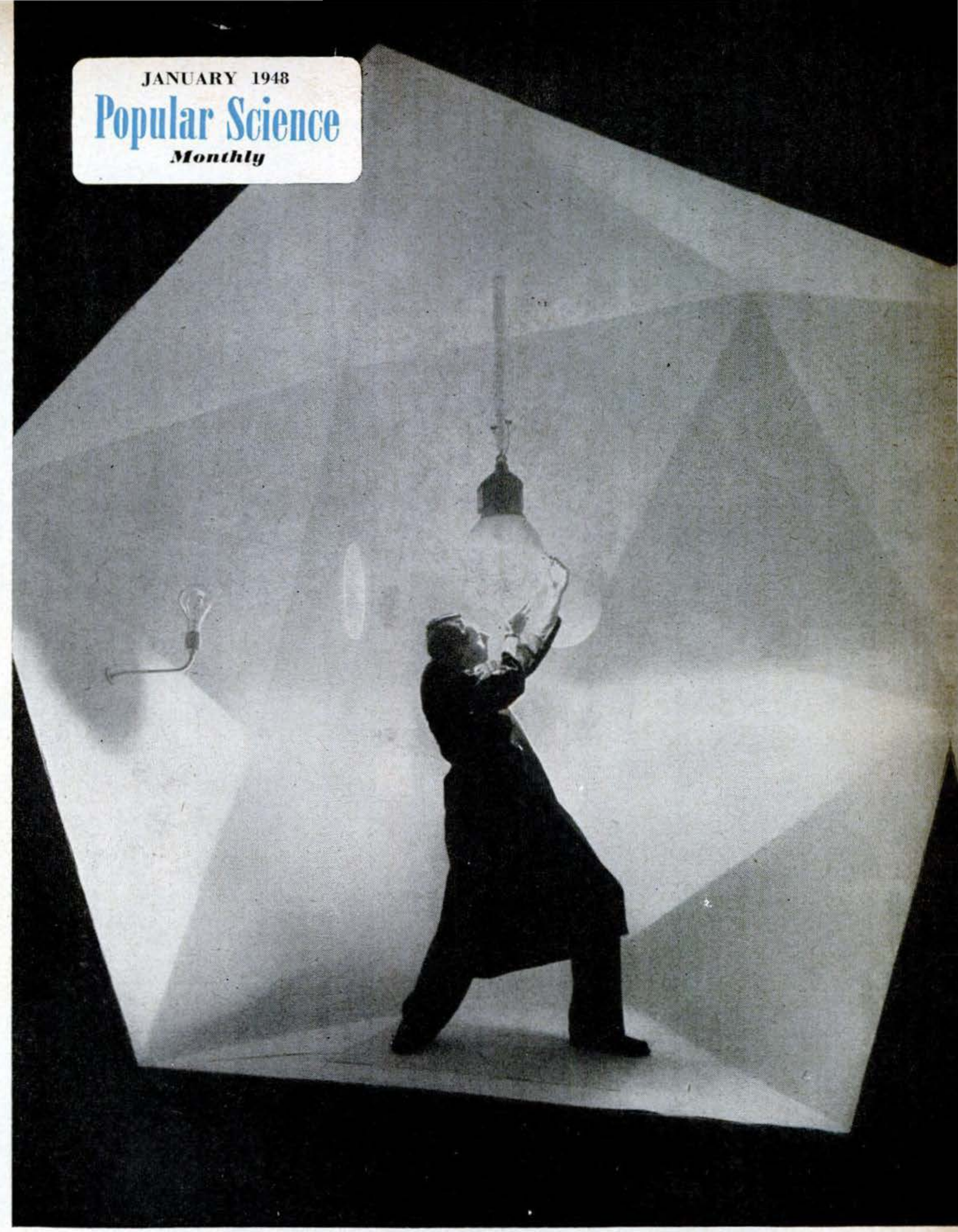
Monthly



Twenty Walls for Better Lights...

This shell is half of an icosahedron—a fancy word for a 20-sided room—used by Westinghouse engineers to test new street-lighting fixtures. When the technician above has adjusted the globe enclosing a bulb, the other half of the odd-shaped room is attached, and multiple walls give an even distribution of light. Brightness is then measured by a photocell mounted in a window at one side. For comparison, a bare bulb is similarly tested in the auxiliary socket at left.

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Little Toni **and pilot Tony LeVier won fourth-place money in first "dirt track" air race.**

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Air racing has been given back to the spectators by flashing new midgets that combine thrills and safety.

Dirt Track in the Sky

By Devon Francis

Kodachromes by Hans Groenhoff

THERE'S a new day dawning in air racing—and it puts the planes practically in the onlookers' laps. Never out of sight of the grandstand, the tiny racing planes belly down on the deck and whip around the pylons like stripped-down stock cars pounding the dusty oval of a county fair. Appropriately, they are homemade.

An event at Miami's All-American Air Maneuvers this month will start the 1948 season of this "dirt-track" air racing. Before the year is out perhaps a hundred such races will be run throughout the United States. The promoters can operate almost anywhere because their sport is cheap—for the same reasons that dirt-track auto racing is cheap. The vehicles don't cost much. Prizes don't have to be high.

The dirt-track airplane is the midget racer of the skies. It doesn't weigh much more than 500 lb. It has less than 100 hp. Yet it makes air racing an exciting spectator sport because its sheer smallness and the way it balances on a wing tip in the turns give an illusion of high speed and the fascination of a three-ring circus.

As a matter of fact, although the midgets can't match the almost-400-m.p.h. speeds of the Thompson Trophy Race, they're not exactly slow. At Cleveland's National Air Races, where the midgets did their stuff for the first time only four months ago, the winning plane averaged 165.857 m.p.h.

Midget zips around pylon on edge, but smallness of rectangular course keeps pilots' speed down. In most races, long legs are about 4,000 feet; short legs, about 1,000. Pilots prefer to fly no higher than 50 feet on long legs. Rules keep them at least 600 feet from stands.

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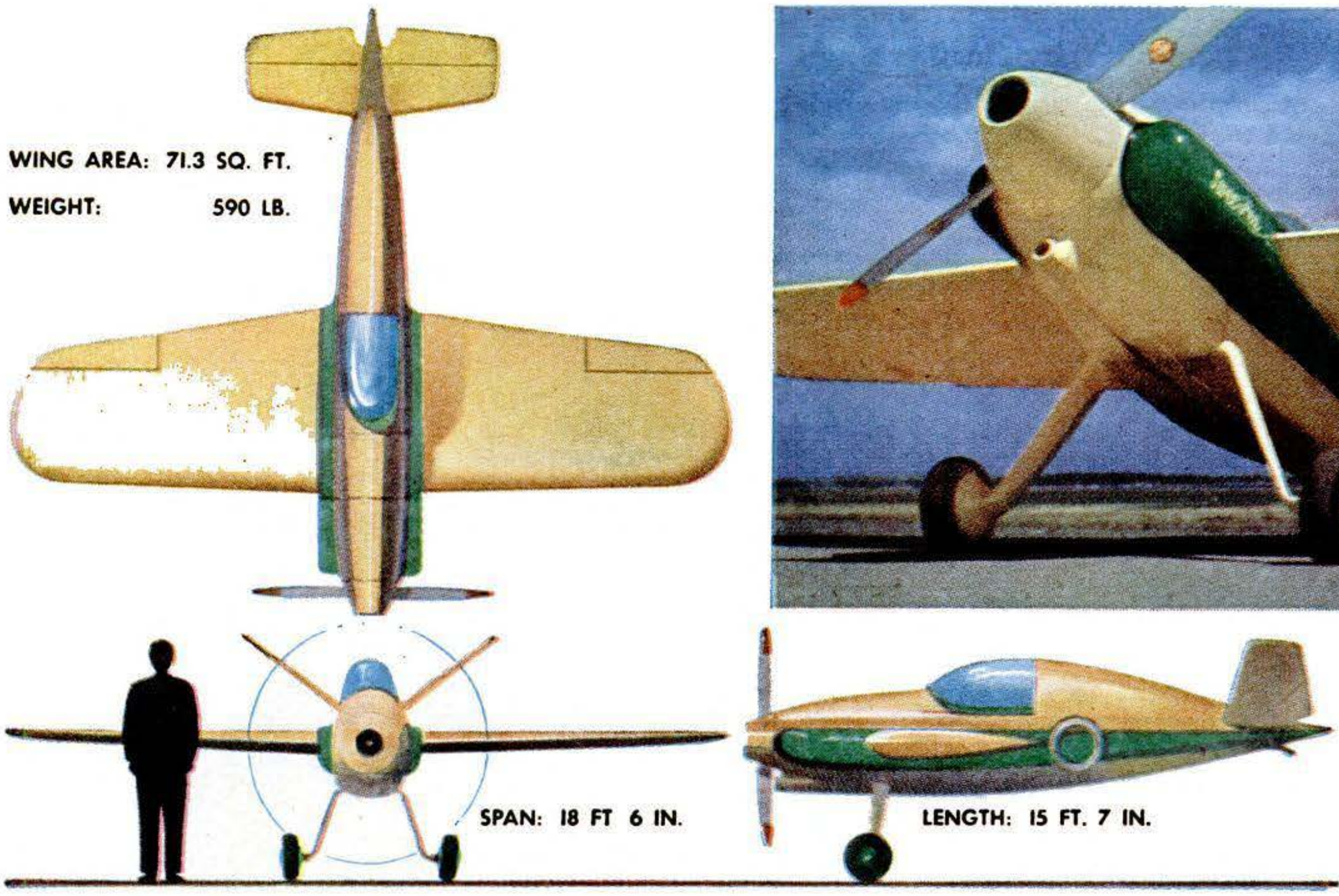

Art Chester's *Swee' Pea* has cockpit only 19 inches wide at shoulder level. Pilot sits three inches above floor on a 12-inch circle of sponge rubber. From backrest to top of instrument panel is 26 inches; and from canopy top to floor, 38 inches. Chester hopes to cut 50 lb. from plane's 590-lb. gross weight by substituting fabric for plywood skin of wing.

And speed, strangely enough, isn't the most important factor from the spectator's viewpoint. "The thing is," remarked one of the paying customers at Cleveland, trying to explain why he got so interested in the midgets, "you can *see* them. Besides," he finished lamely, "they fly low and make a lot of noise."

Ever since the early '30s, when speeds in organized air racing began to zoom, closed-course airplane races have not been a spectator sport. The pace they set demanded a course many miles long. That meant putting all but the home pylon so far away from the stands that telephone-equipped spotters had to relay the progress

This midget, owned by Steve Wittman, collected first place and $8,500 in last fall's Goodyear Trophy Event. Pilot was 22-year-old Bill Brennand of Oshkosh, Wis. The course, with four turns, was only 2.2 miles long. Race was 15 laps. The plane was rebuilt from a higher-powered job in which Wittman set international and national 100-kilometer records in 1937.

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of a race to the airport for announcement over the loudspeakers. All that the paying customer got for his money was a blur of airplane across the field every couple of minutes.

By the time the war interrupted big-time air racing, speeds had climbed above 280 m.p.h. When the Nationals were resumed in 1946, jet-propelled aircraft added to the confusion—and dissatisfaction—of the guy up in Row Z in the bleachers who wanted to see what was going on.

Then and there, dirt-track air racing was born. It had been thought of half a dozen years before by some pilots who sensed whither the sport was drifting. Now, with the war over, it was costing too much to convert government-surplus fighters into racers. More important, they could see the time coming when the turnstiles wouldn't make music any more.

The pilots got together with the Goodyear Tire and Rubber Company. The company put up some substantial prize money. The pilots drew up the rules and specifications and built the planes.

The pay-off came at the 1947 Cleveland air races. The midgets collected $25,000 of Goodyear's prize money. And while four of the lightning-fast big planes crashed and one man was killed, the dirt trackers performed with respectable safety due to relatively low flying and landing speeds.

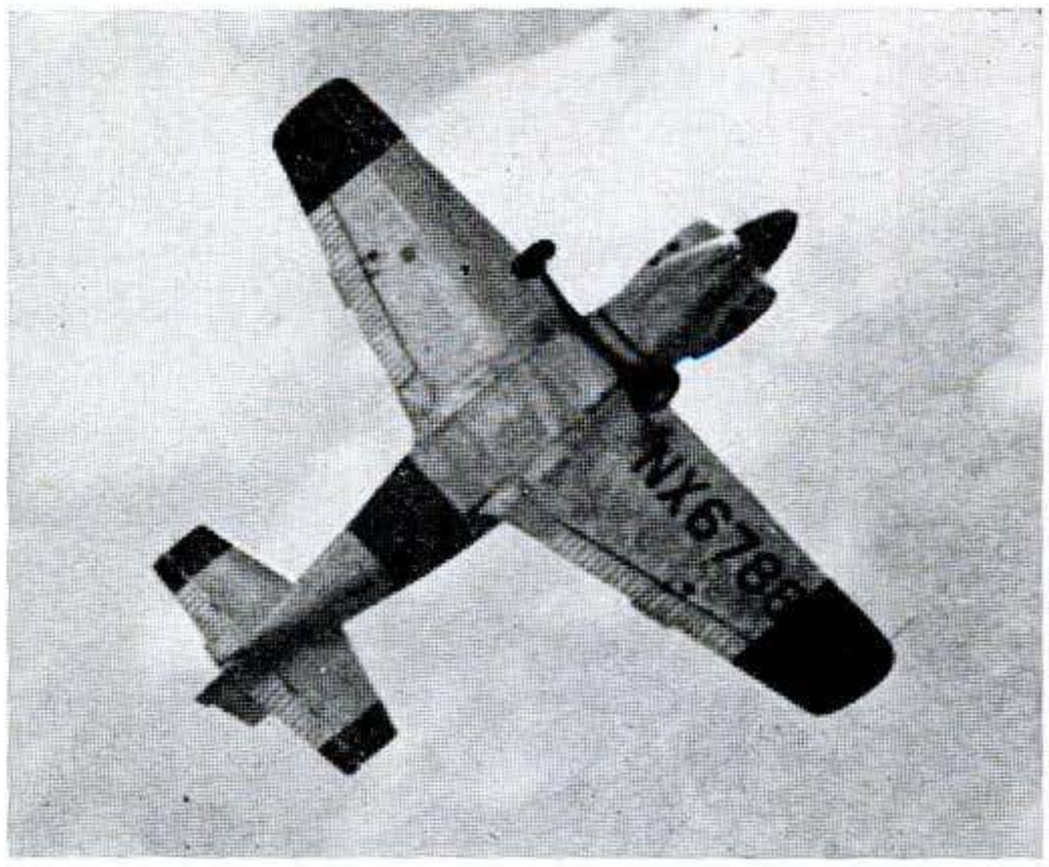
More important, the crowd—and the press—liked them. Thereupon a couple of fellows named Tony LeVier and Art Chester shook hands all around with their brother pilots. They had hit the jackpot.

Midget air racing was presented to the public full-blown. Rigid rules for ships and pilots had been approved by the National Aeronautic Association, arbiter of all U. S. air racing. Engines cannot exceed 190-cubic-inch cylinder displacement — which means they can't turn out more than 86 hp. wide open. They must be government-approved stock types, and may not be altered "except as approved by the manufacturer."

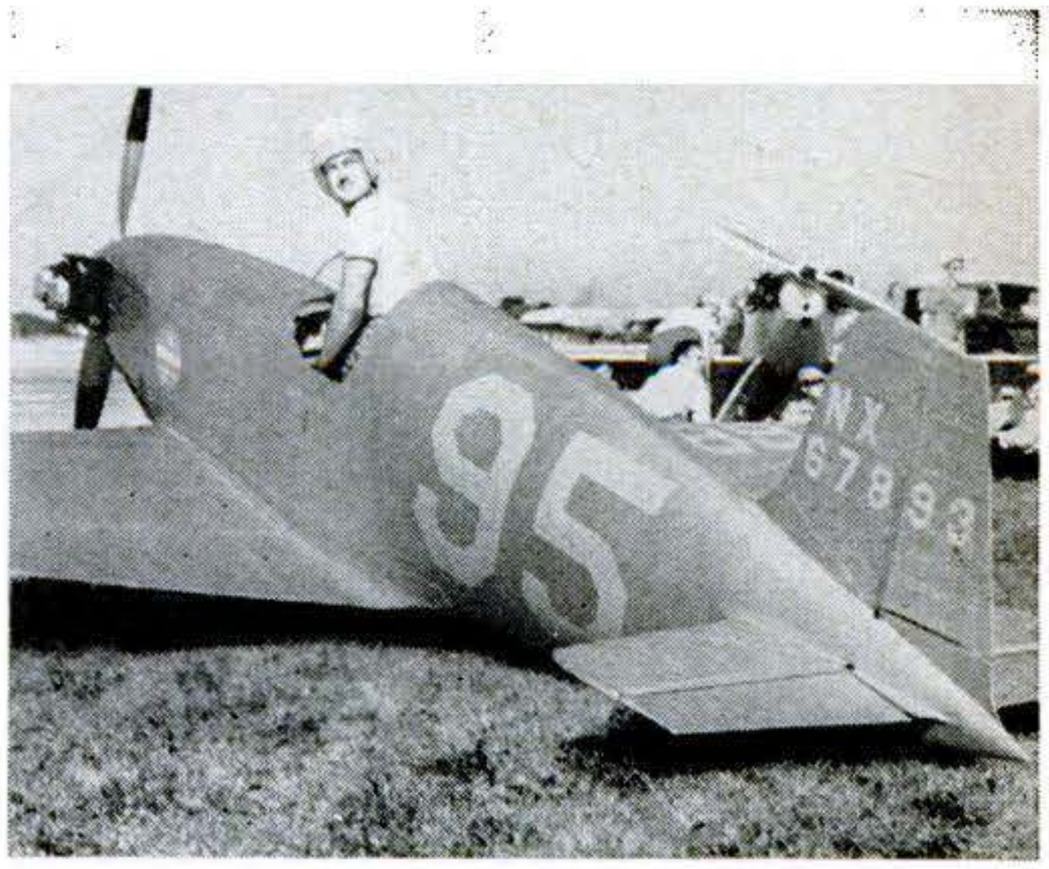
SAFETY is a prime consideration of sponsors of midget air racing. Here strength of *Cosmic Wind's* wing is shown as it easily supports seven adults and a child.

Propellers must have a fixed pitch. A midget's wing loading—the amount of gross plane weight for each square foot of wing area—may not exceed 12 lb., about that of the average two-passenger sport plane. Landing gear must not be retractable.

Planes must be tough enough to take stresses six times the force of gravity in prerace tests, and do three laps of an established course at full throttle—including the turns. They may not have lift flaps, but drag flaps are allowed.



Cosmic Wind, in the air above, is only four feet high and 18 feet long, but owner LeVier hopes she'll hit 180 m.p.h. Wings, whose roots resemble those of Shooting Star, span 19½ feet.



Californian has molded plastic skin and very thin plywood wing covered with linen. She is owned by E. F. Allenbaugh, of No. Hollywood. There are midget enthusiasts all over U. S.

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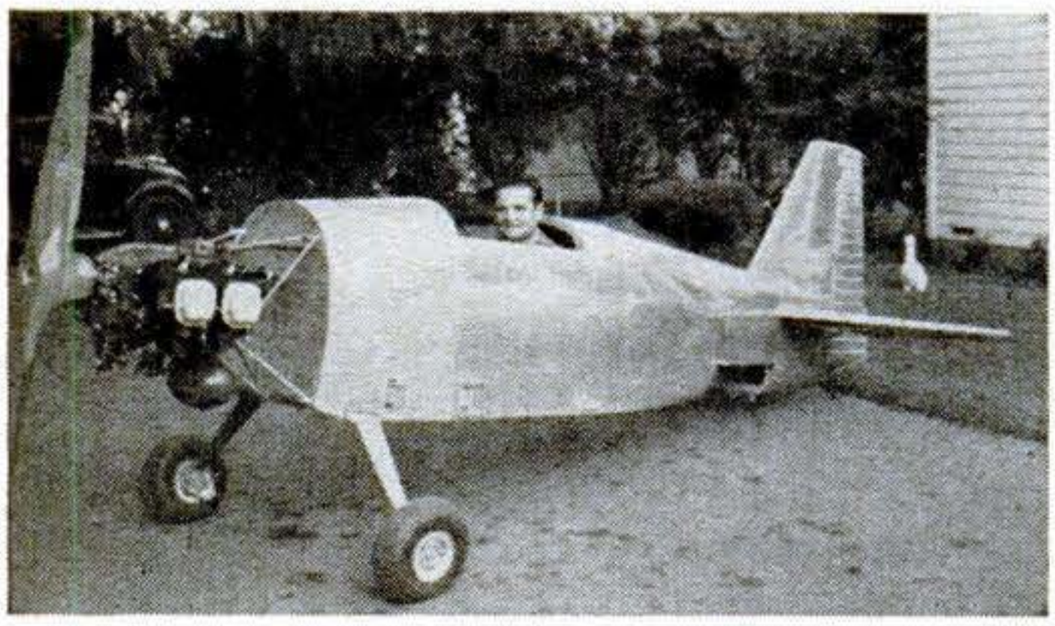
Pilots must wear parachutes, safety belts, shoulder straps, and crash helmets. They must have had 500 solo hours—or equivalent experience in their particular racer.

The midget planes themselves are backyard aircraft in every sense of the term. LeVier's *Cosmic Wind,* for example, came to life in six separate garages around Los Angeles. LeVier—chief test pilot for Lockheed—Herman Salmon, and a group of their friends worked on it. They figured and cut and fitted until they got something that would fly.



COCKPIT of *Little Toni* is considered roomy, but a shoehorn is needed to get into some midgets. Here wings are off while tail group is cleaned up and engine tuned.

They estimated that they could get 185 m.p.h. on the straightaway. But when they were finished they found they had trimmed too closely. They had to make the ship bigger to bring it up to the minimum and add wing area to hold down the wing loading. As a result of this unplanned-for drag, the modified job turned up only 170 m.p.h. at full throttle. LeVier and his friends built two of these planes on similar lines. Now they are experimenting to get back that lost speed.

Of the dozen midgets on the starting line at Cleveland, a few were old timers that had been modified to meet the rules. Bill Brennand's winner, owned by Steve Wittman, the one-time Oshkosh school teacher, was one of them. But construction of the true midgets has begun in earnest now, and dozens of them will be squatting on starting lines all over the country in the next few months.

What makes one midget better than another, pilots being equal, is hard to find out. The designers-builders-pilots are secretive, so secretive in fact, that the Professional Race Pilots Association has had to assure all entries that designs and performances will be held confidential.

Nevertheless, some tricks are obvious. *Swee' Pea,* designed by Chester, president of the Association, and flown at Cleveland by Paul Penrose of North Hollywood, Calif., dispenses with coolant air intakes at the sides of the engine altogether and feeds air in through a hole in the spinner in the nose. Wittman, Chester, and LeVier use thin spring steel for their landing-gear legs to cut down air resistance. Canopies are as small as the rules allow—just high enough to clear a crash helmet. LeVier plans to whittle down his 62-inch propeller by three or four inches. That will reduce his take-off thrust, but should give him more engine revolutions, boosting his air speed.

There isn't much that can be done about the engine—a man can only polish the valve ports or experiment with fuels. Supercharging, incidentally, is forbidden.

All of the ships are mid-wings or low-wings. Most of them have full cantilever wings because external bracing would increase drag. Controls for the most part are orthodox. Chester, however, has gone in for the V-type tail, combining rudder and elevators as in the Beech Bonanza personal plane (PSM, Oct. '46, p. 97). In weight, the midgets that have appeared so far vary from Wittman's 506 lb. to 662 lb. for the Hurlburt Hurricane, built in Cleveland. Wittman pulled a neat one in picking a jockey for his low-weight racer. Brennand, top-flight winner, weighs only 105 lb.

There may be some new wrinkles in design in the coming months. Edward F. Allenbaugh, of North Hollywood, has plans for a racer with the propeller in the tail. W. T. Wedding of Las Vegas, Nev., has suggested a design wherein the pilot would lie on his stomach, thereby chopping down frontal area and drag.

Design depends mostly on the way a race is to be flown, and this in turn depends on the individual convictions of the pilots as to what wins races. Chester thinks "initial momentum" is all important.

"Get her rolling and light on her wheels," is his formula.

Most midgets are off the ground in 600 to 700 feet. Shortening the run, in Chester's book, is less important than speed in the getaway. If he can get plenty of daylight between his tail cone and the rest of the field, he is set up to make short, sharp turns around the pylons, "hugging the rail."

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He also can be free of the turbulent air from the prop washes of planes ahead of him.

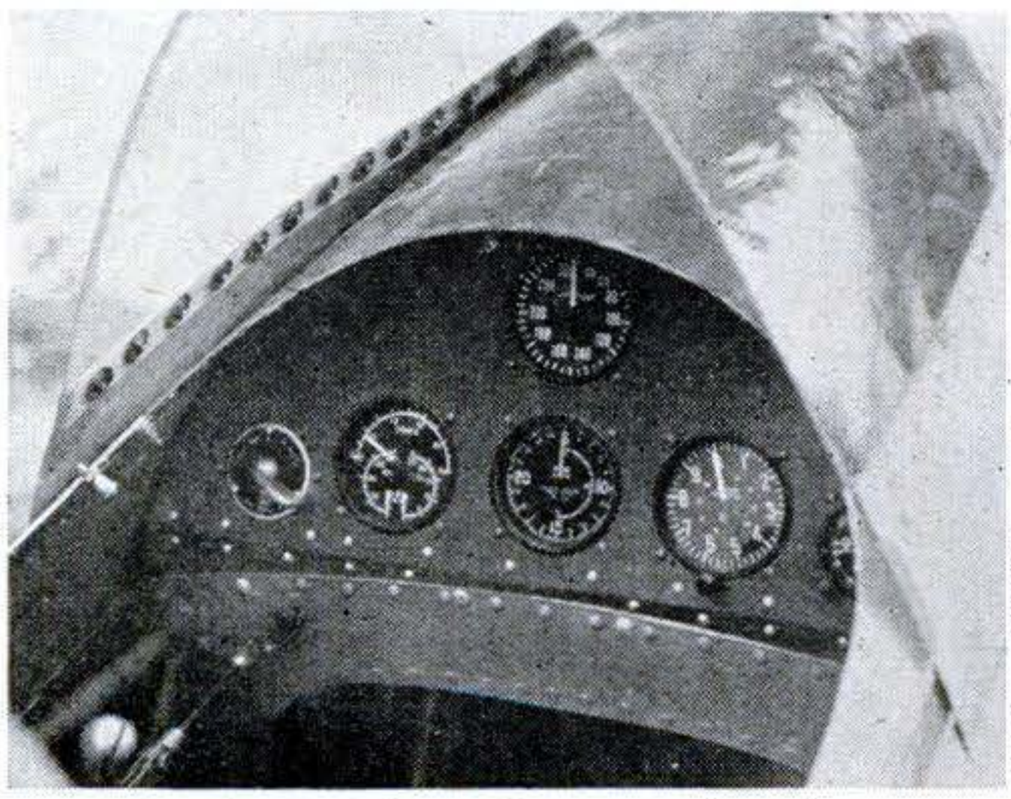
The rules provide that one pilot can't cut in front of another until he is leading by 150 feet. Ordinarily this means that he must accumulate the lead footage and 25 to 50 feet of altitude besides, so that he can dive on a turn in a bid for pole position.

Much attention is given to consistently high engine speeds. In a satisfactory turn the engine will lose no more than 100 revolutions. Propellers must be designed and pitched for fast reaccelerations, for the amount of time they require to speed up governs the engine revolutions, and power means the difference between finishing in or out of the money.

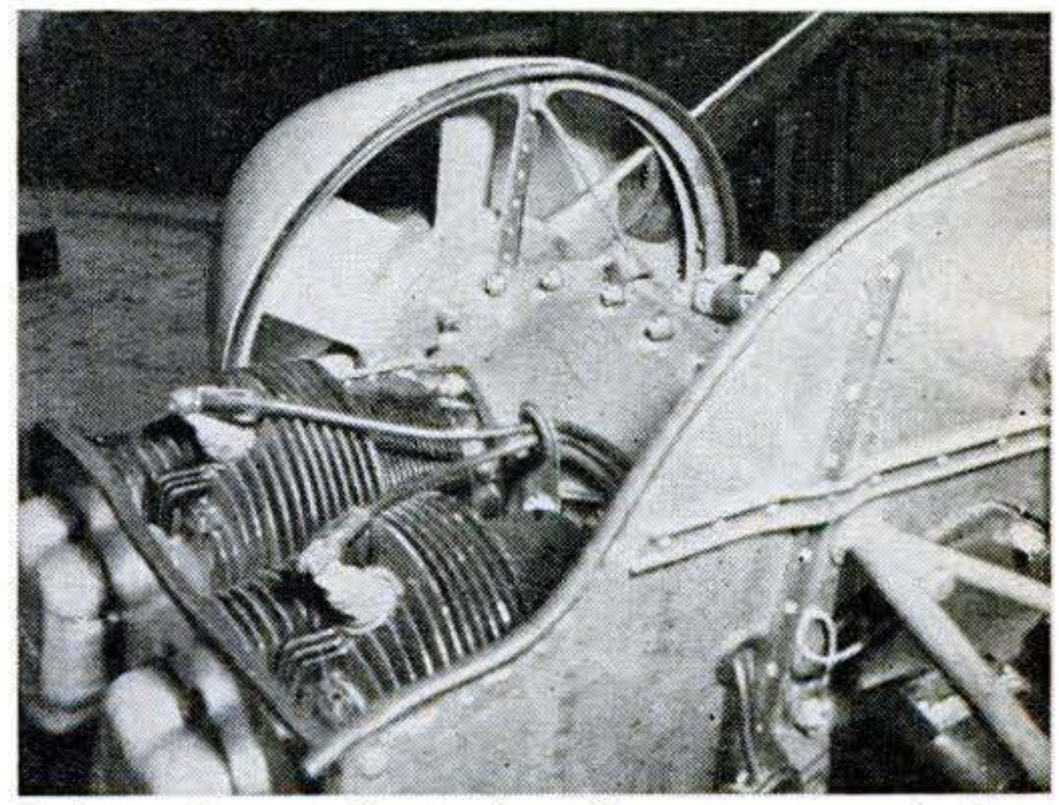
The midget plane is nothing new to air racing. There were midgets years ago. What is new are the elaborate rules, the extremely limited horsepowers, and a sharp sense of showmanship in the participants.

"The midgets," says LeVier, "should create a new form of competitive sport."

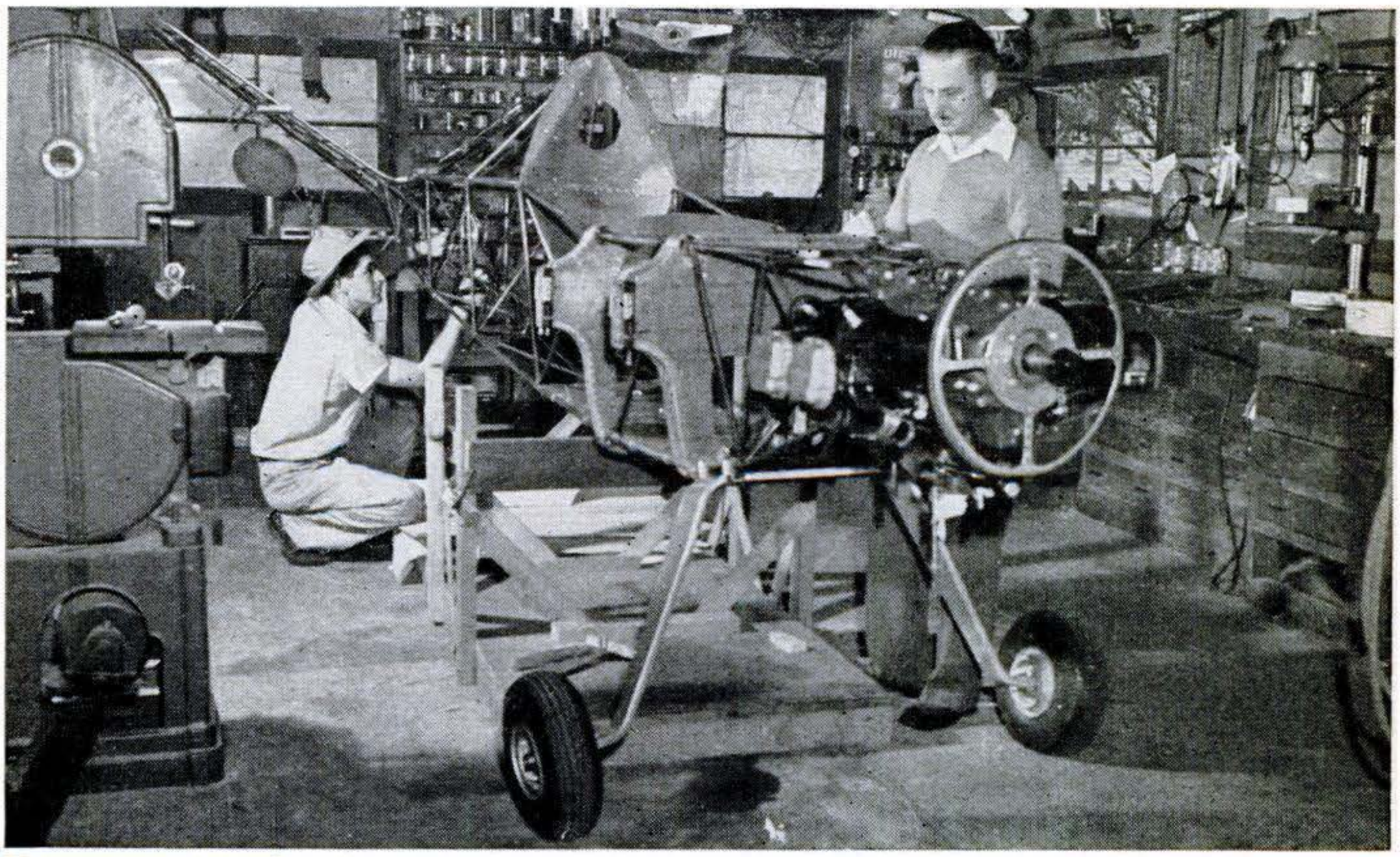
The look on the customers' faces shows that they think so too. END



A midget's dashboard carries (top) air speed indicator; (bottom, l. to r.) ignition switch, oil and fuel gauges, tachometer, altimeter, clock. The throttle is at lower left.



Lifting hood of *Swee' Pea's* engine reveals four vanes that support spinner and drive air back from hole in center to cool engine. Under rules, fuel injection instead of carburation is optional.



Home workshops breed many midgets, as here where Art Chester is fabricating the fuselage of his third racer. The structure is taking form on a wooden jig. The plane will be nearly 50 lb. lighter than the racer that Paul Penrose pushed to second place at Cleveland.

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It's as simple as this to repair new fix-it-yourself radio. Throw-away units, resembling tubes, contain its circuits. Replace the defective one as shown, and program goes right on again. AC-DC home model, a five-tube superheterodyne, has a standard table-top cabinet.

Color identifies tubelike circuits, which come in cartons of same hue, so purchaser who has no knowledge of radio can be sure of getting the right part. Complete set above includes virtually all that is needed, besides standard tubes, to keep radio as good as new.

Mother Could Fix This Radio

PSM photos by Robert F. Smith

YOU don't need to know a coil from a condenser to fix this radio. Throw-away units, as easy to change as radio tubes, contain practically everything that might go wrong in the set. Six "canned" circuits with pronged bases, designed to retail in department stores at $1.85 apiece, replace the maze of wiring located in back of the dial of a conventional radio.

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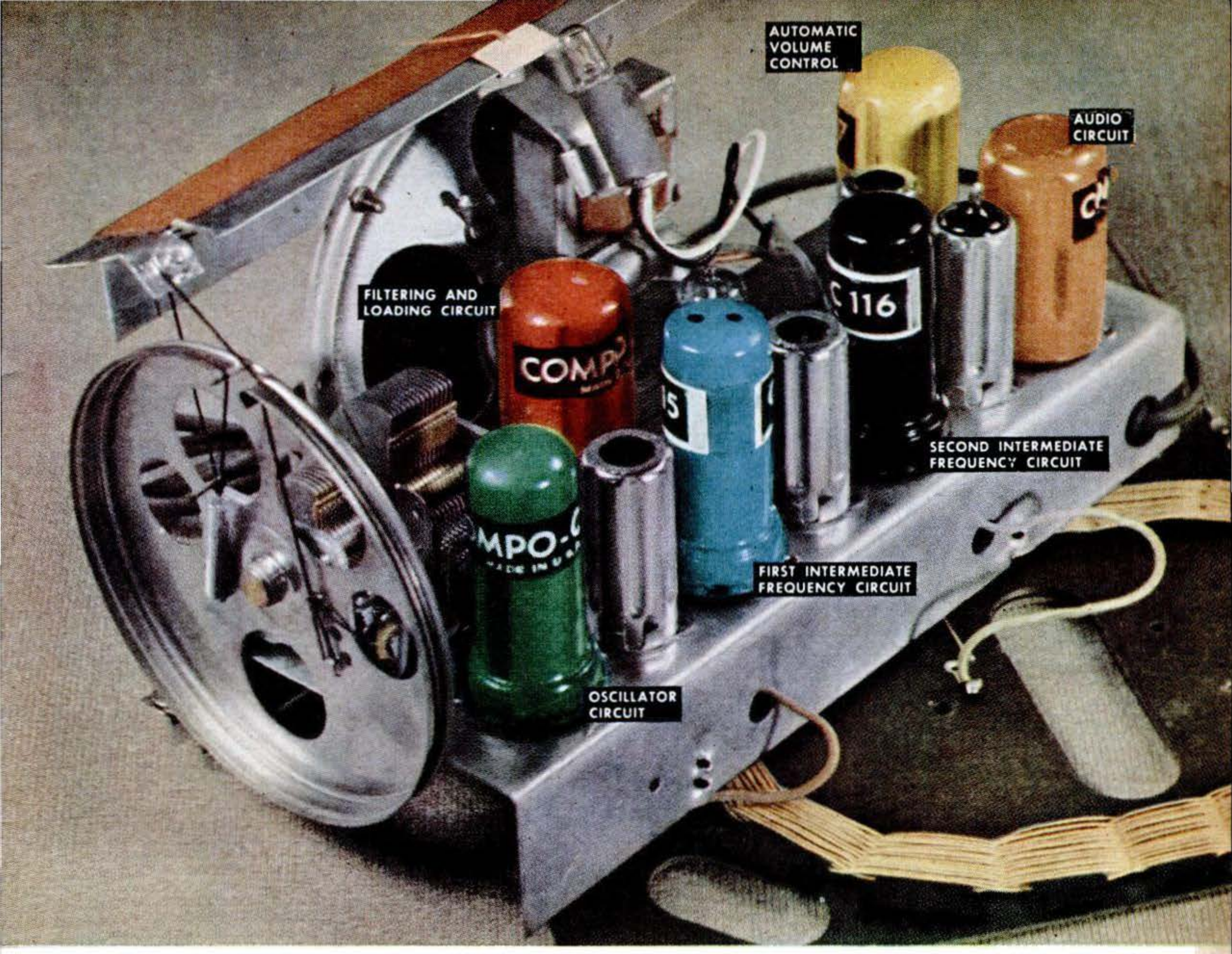


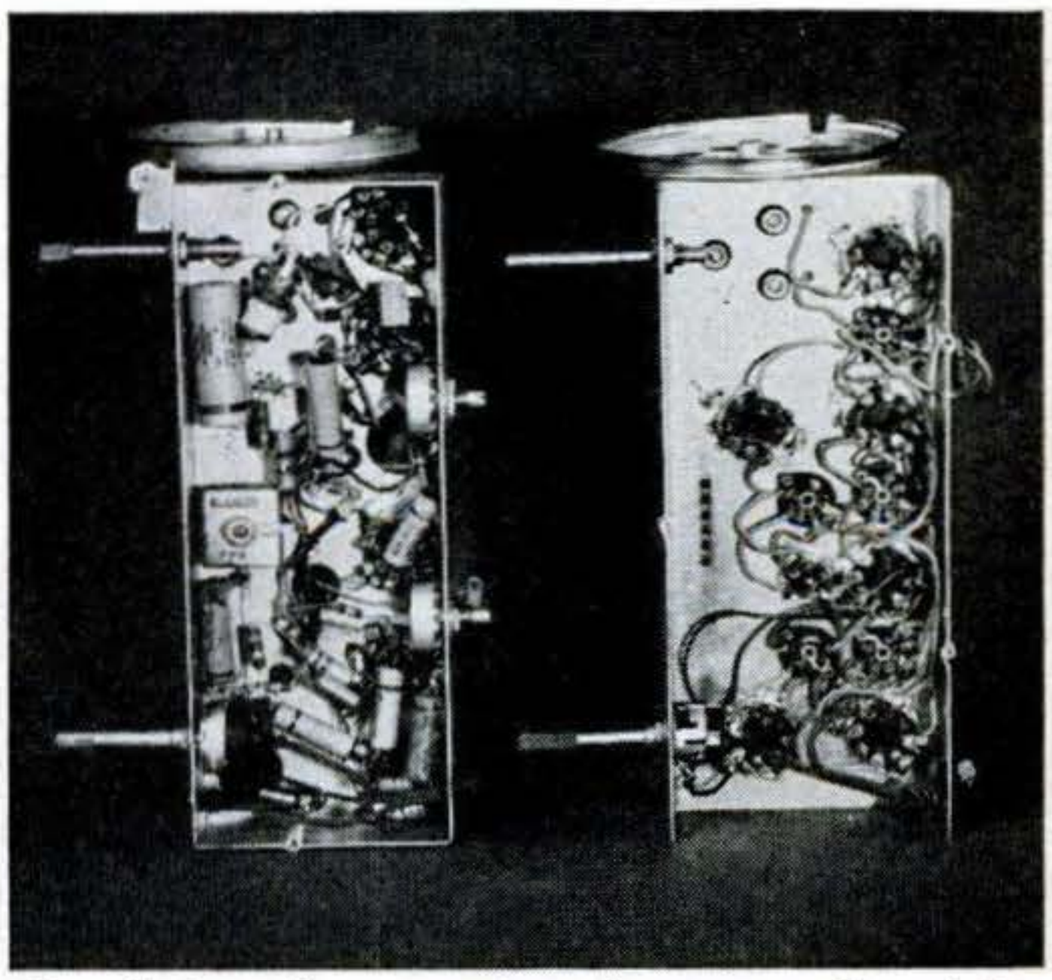
The chassis, above, is removed from cabinet to show arrangement of its six "canned" circuits in throw-away units. Their color code makes it easy to insert new parts in right places. The smaller "cans" of plain metal, three of which are in foreground, hold the five standard tubes.

If the set stops working but the tubes remain lit up, trouble in one of these units is indicated. Taking the radio to the nearest store, the owner can find by experiment which replacement to buy. Or, if he prefers, he can buy a complete set of the inexpensive spares to have them on hand.

Color Identifies Parts

Parts may be asked for simply by color, without need of remembering names or numbers. A green "can" contains the oscillator circuit, a brown one the audio circuit; blue, black, red, and yellow identify, respectively, the first and second intermediate-frequency circuits, filtering and loading circuit, and automatic volume control.

First production model, introduced by the Cosmo Electronics Corp., New York City, is a five-tube home receiver. Also planned is an automobile radio for which any service station would supply the replaceable parts.



Simplicity of connections in new radio, right, contrasts with maze of circuits beneath conventional set at left. Condensers, resistors, and other parts that might get out of order have been transferred to packaged units, which can be changed just like the tubes themselves.

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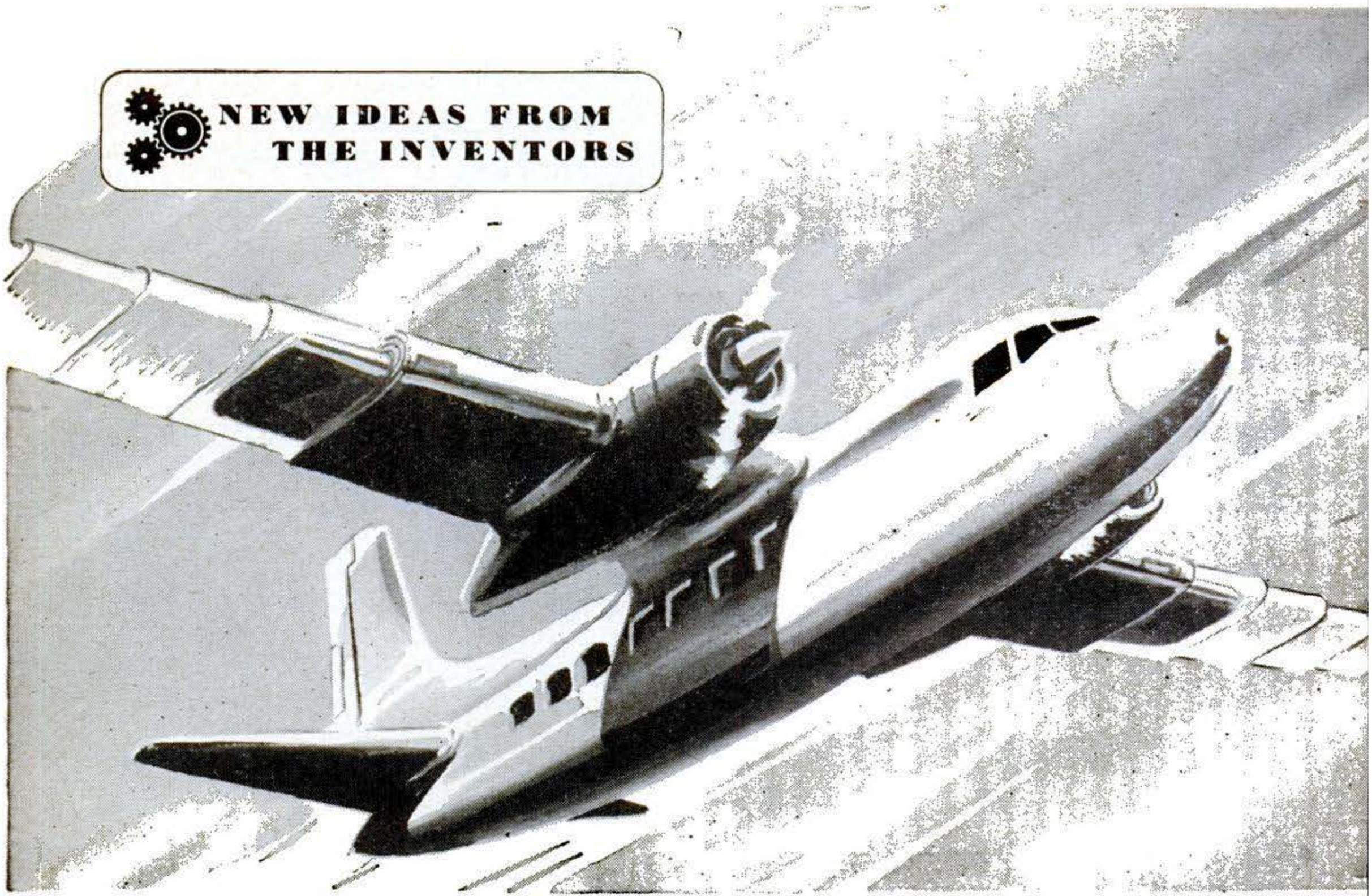
NEW IDEAS FROM THE INVENTORS



Wing Changes Its Area. This telescoping airplane wing, invented by Thomas F. Gibson, of Cleveland Heights, Ohio, is designed to be extended at take-off for maximum lift and then retracted as the plane attains full speed and altitude. As fuel consumption lightened the plane, wing would be pulled in more to cut wind resistance.

Iron Tips Itself Up. You wouldn't have to worry about burned ironing boards if you had this iron—the moment you let go of it, it rocks back on its heel, lifting its heated surface from the board. Weighted in the rear, it needs only light pressure to keep it in ironing position. It was invented by Earl M. Schara, of Washington, D. C.

Wheelbarrow Folds Flat. This collapsible wheelbarrow was designed to fit in a closet or the trunk of a car. Its bottom, hinged along the middle, folds in two as the side walls are brought together. Front and end walls, hinged like doors to one of the sides, also fold flat. It was invented by Charles H. Bates, of Independence, Mo.

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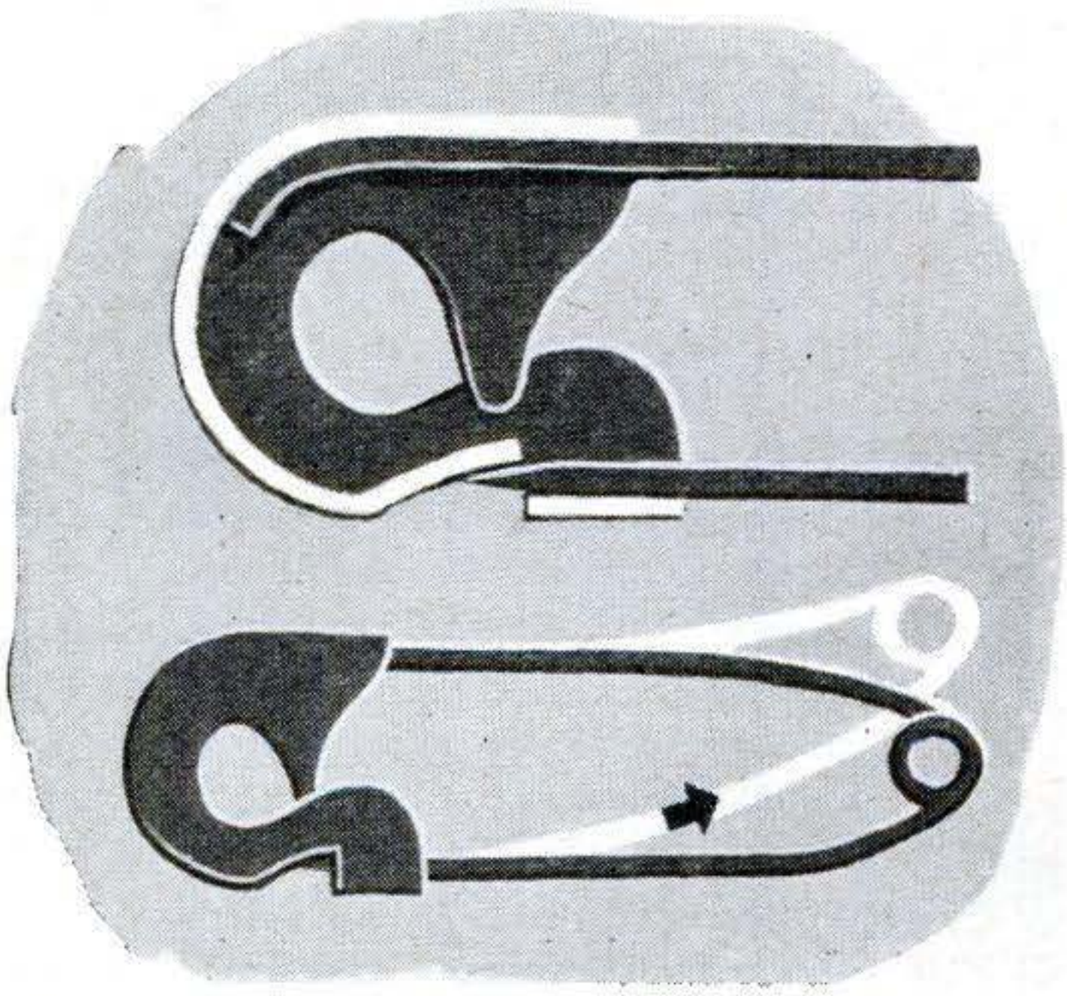
Boat Becomes Trailer. Hinged in the middle, this novel boat can be folded in half and then, with the addition of a small trailer wheel, towed by a car. Patented by Leonard J. Rutledge, of Jackson, Mich., it forms a rainproof storage compartment for food and gear. For use as a boat, its halves are bolted together again.



Safety Pin Locks Shut. A safety pin that really lives up to its name is the object of inventor Raymond R. Rundell, of Miami, Fla. Closed first in the usual way, the pin is then locked by pulling back the prong until the point slips into a slot in the head of the pin. This holds the point until the same process is repeated to remove it.

Pot Shield Stops Steam. To save the hands from steam burns while stirring the contents of a double boiler, Octavia E. Armstrong, of Salinas, Calif., has patented a shield for the rim of the upper pot. Thickest at the handle for maximum protection, it narrows on the opposite side to provide a harmless escape for the rising steam.

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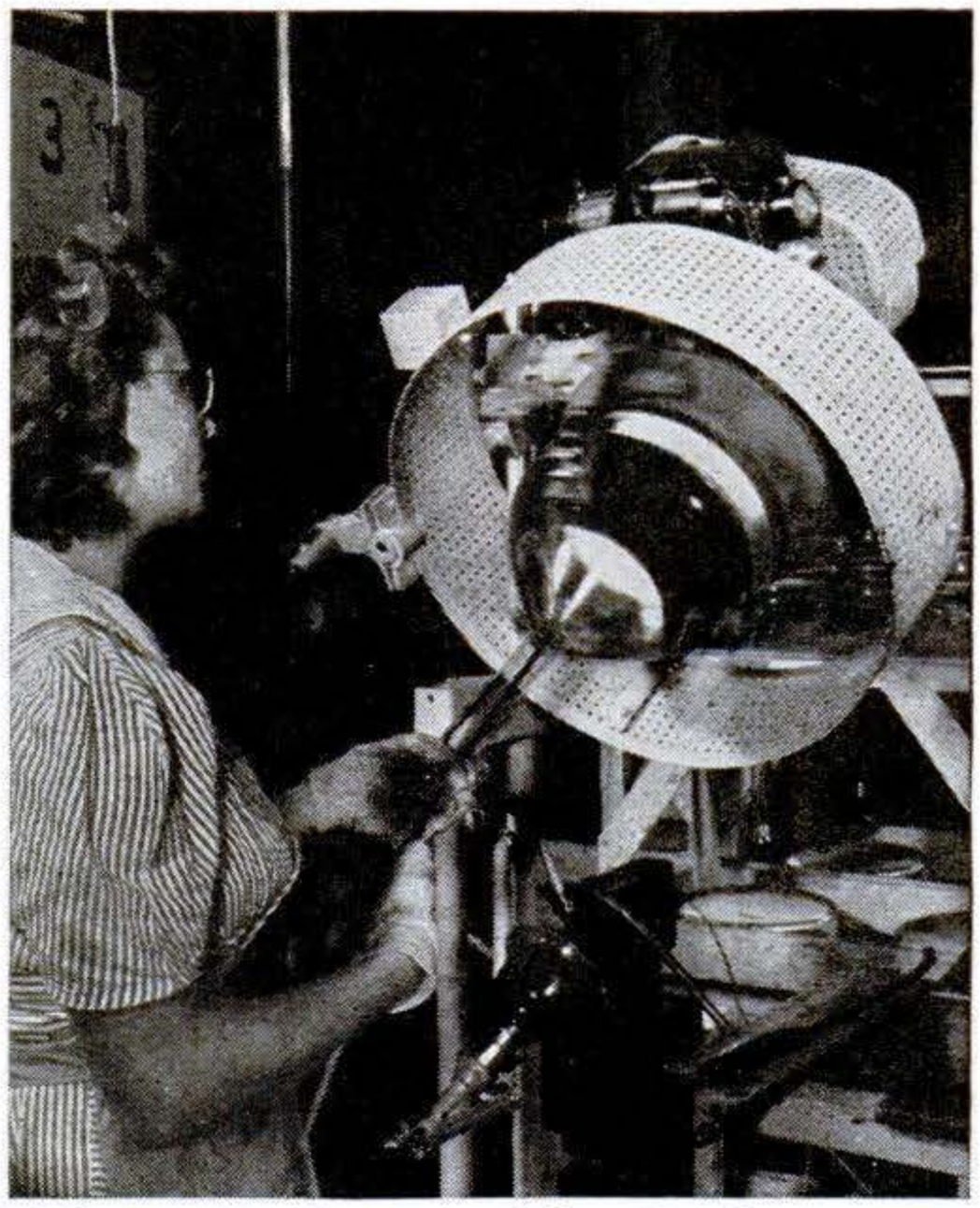
The empty bulb that will become a television picture tube is preheated on a 16-head rotary machine, as shown above, before the metal button for the second anode is inserted in its side. The button is made of a special alloy that conducts electricity well and also forms a vacuum-tight weld with glass wall of the tube.



Following application of the phosphor coating, which glows to produce the television picture, the inside of a tube is swabbed with a mixture of graphite and silver that forms a conducting surface. This machine rotates the bulb while the operator holds the swab inside. Later a similar coat is applied to the outside.

60 Television Tubes an Hour

They're being made faster and cheaper now.

PSM photos by W. W. Morris

TELEVISION for everybody comes a step closer with the development of mass-produced picture tubes, the heart—and one of the most expensive components—of video receivers. RCA's new plant in Lancaster, Pa., is already set up to turn out one of the big cathode-ray tubes every minute, and at a price that may reduce the cost of small television sets.

These tubes are lineal descendants of the ordinary neon sign, or gas-discharge tube. About 80 years ago the British physicist Crookes pumped all the gas out of a discharge tube and found that the light inside the tube disappeared, but the end of the tube itself began to glow! His interest aroused by this effect, Crookes proved that it was caused by a stream of extremely small charged particles coming from the negative electrode in the tube.

Other scientists added electrically charged metal plates to control the electron beam, producing the modern cathode-ray tube that has proved so valuable to physics. J. J. Thomson used it to measure the ratio of charge to weight of the electron. More recently it has furnished the viewing screen for radar, and the oscilloscope.

These same cathode-ray tubes make the picture end of television receivers. They are so difficult to manufacture, however, that until now they have been constructed by hand and were therefore expensive. With the production of television receivers expected to top a half million sets in 1948, hand methods had to go. RCA engineers devised machines and conveyer systems that practically eliminate the human element.

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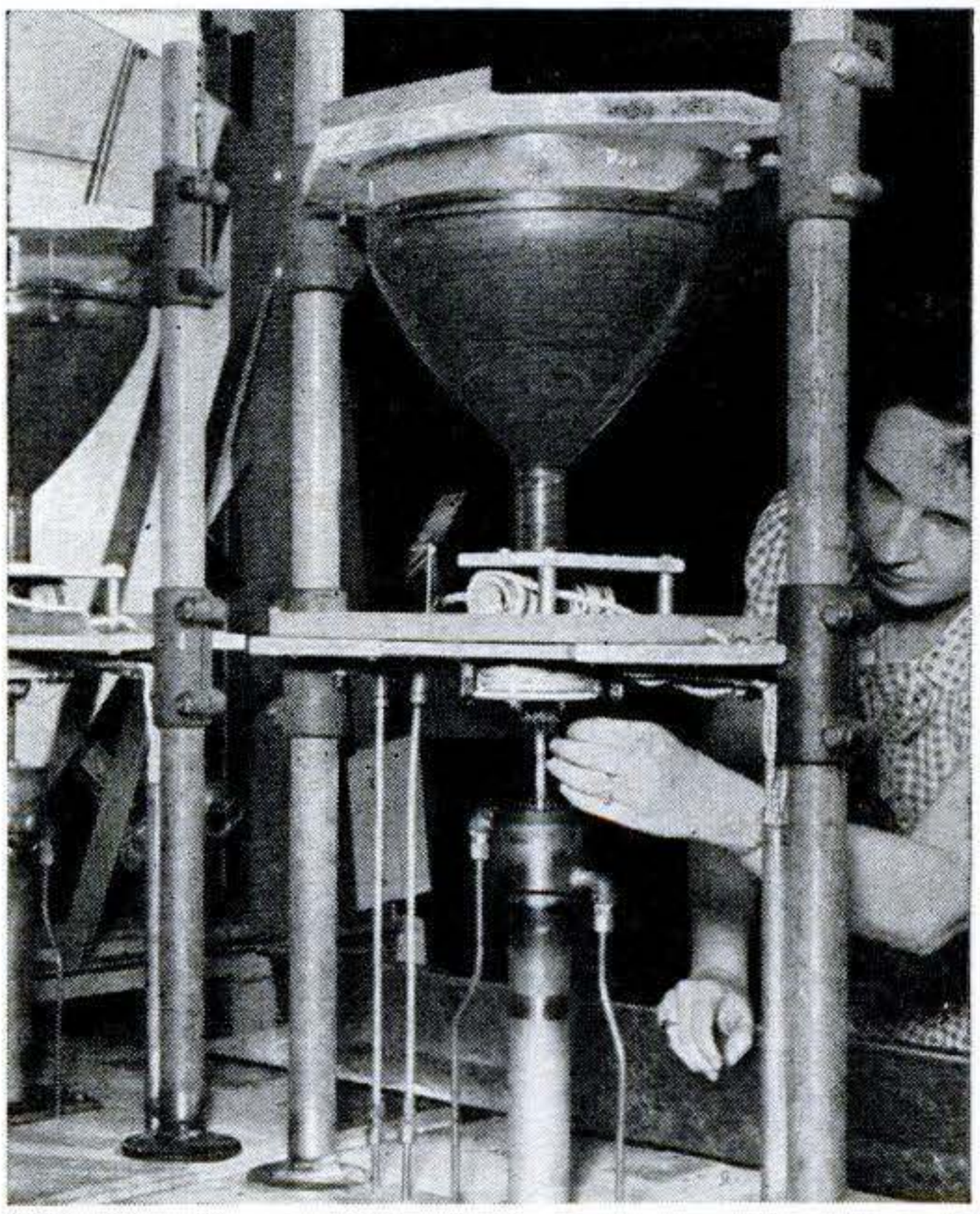
Automatic burners seal a glass ring to the head wire, on which the electrodes are mounted. After the stem is sealed to the bulb, it will be ready for the vacuum pumps. A big problem in designing this mass-production system for cathode-ray tubes was cleanliness. No machine could be permitted to stir up dust, leak oil or grease, scratch or strain the glass. The building is air conditioned, and much of the equipment for heat-treating is surmounted by fans to suck away dirt, and curtained with spun glass to keep out drafts. Even the plant floor is inlaid with waxed maple blocks so that workers will not scuff up tube-spoiling dust.



Terminals are connected to a power line before tube enters the exhaust machine, so that the elements can be turned on, insuring good vacuum. During the 64-minute trip through this device, pressure inside the tube is reduced by steady pumping to 10,000 million times less than outside pressure.

The final step is testing. A special pattern made up of Indian heads, lines, numbers, and letters was designed by engineers to indicate a tube's ability to produce a clear image. If this inspector is satisfied with its performance, it is ready to be assembled into a television receiver —and to bring you the prize fights.

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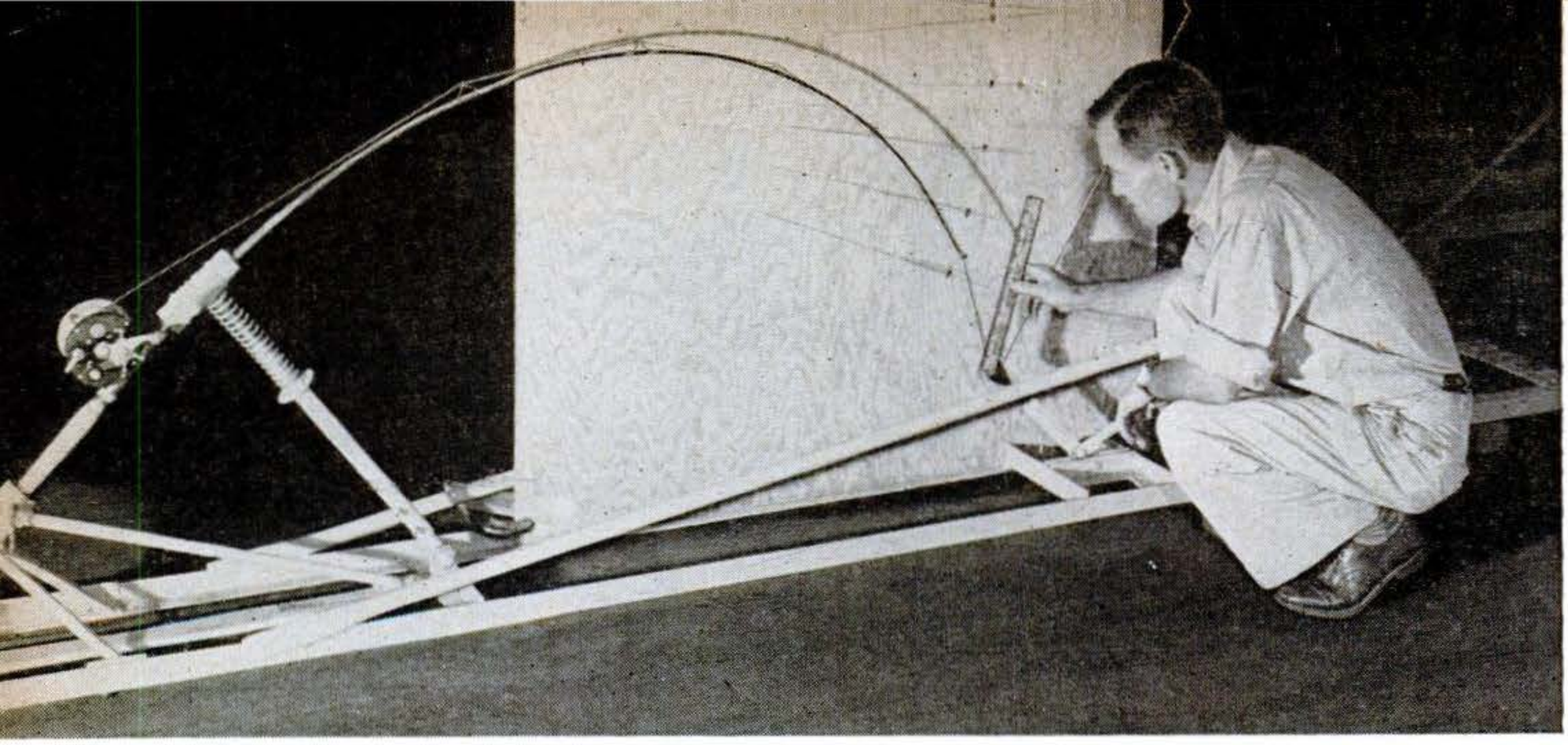
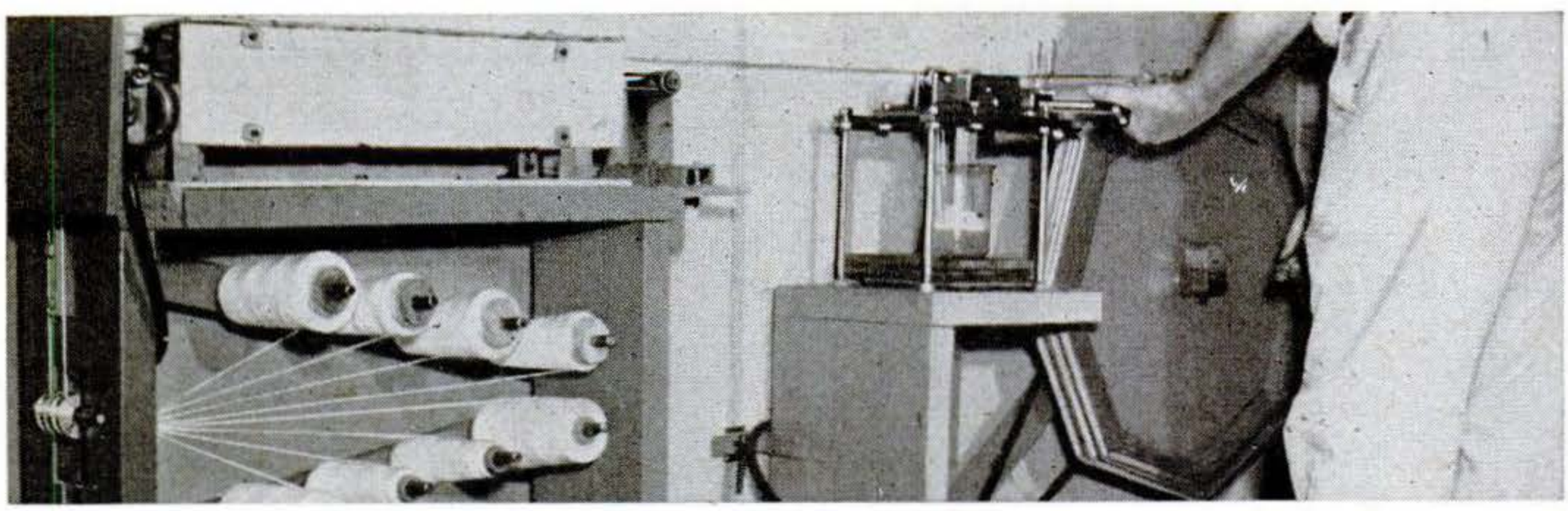


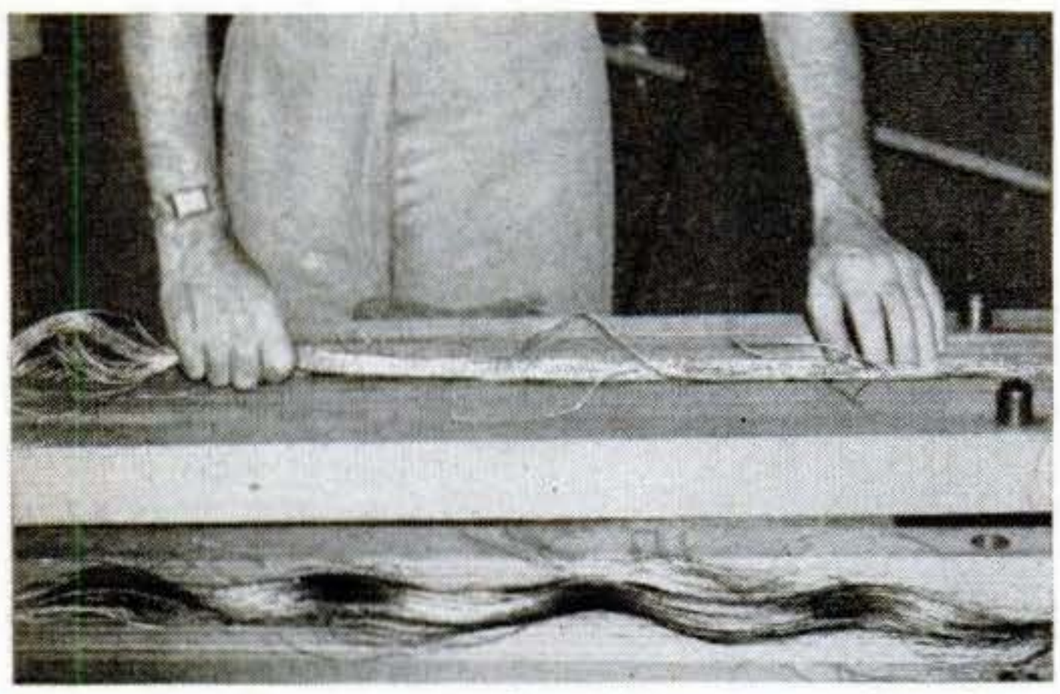
Testing the toughness of glass-fiber rods. One, flexed 100,000 times, remained good as new.

Glass Rods Can Land Big Fish

WHEN a 4-oz. rod lifts 18 pounds of dead weight and bends 110°, that's one answer to a fisherman's prayer for lighter and stronger tackle. And that's the claim for these glass-fiber fishing rods, a by-product of wartime research, by Tycoon Tackle, Inc., of Miami, to find a substitute for bamboo.



From these little spools of glass fibers, left above, grow big fishing rods. Above right, the raw glass fibers go through plastic bath, are then subjected to heat treatment before being wound on a modern cousin of the old spinning wheel, shown at far right, ready for the next step.



Strands of treated glass fibers are placed in iron molds. A bonding solution is added and heat welds fibers around a central wooden core.

After wrapping, glass rods are polished. Then guides and fittings are added to hold the line and reels. The rest is up to the fisherman.

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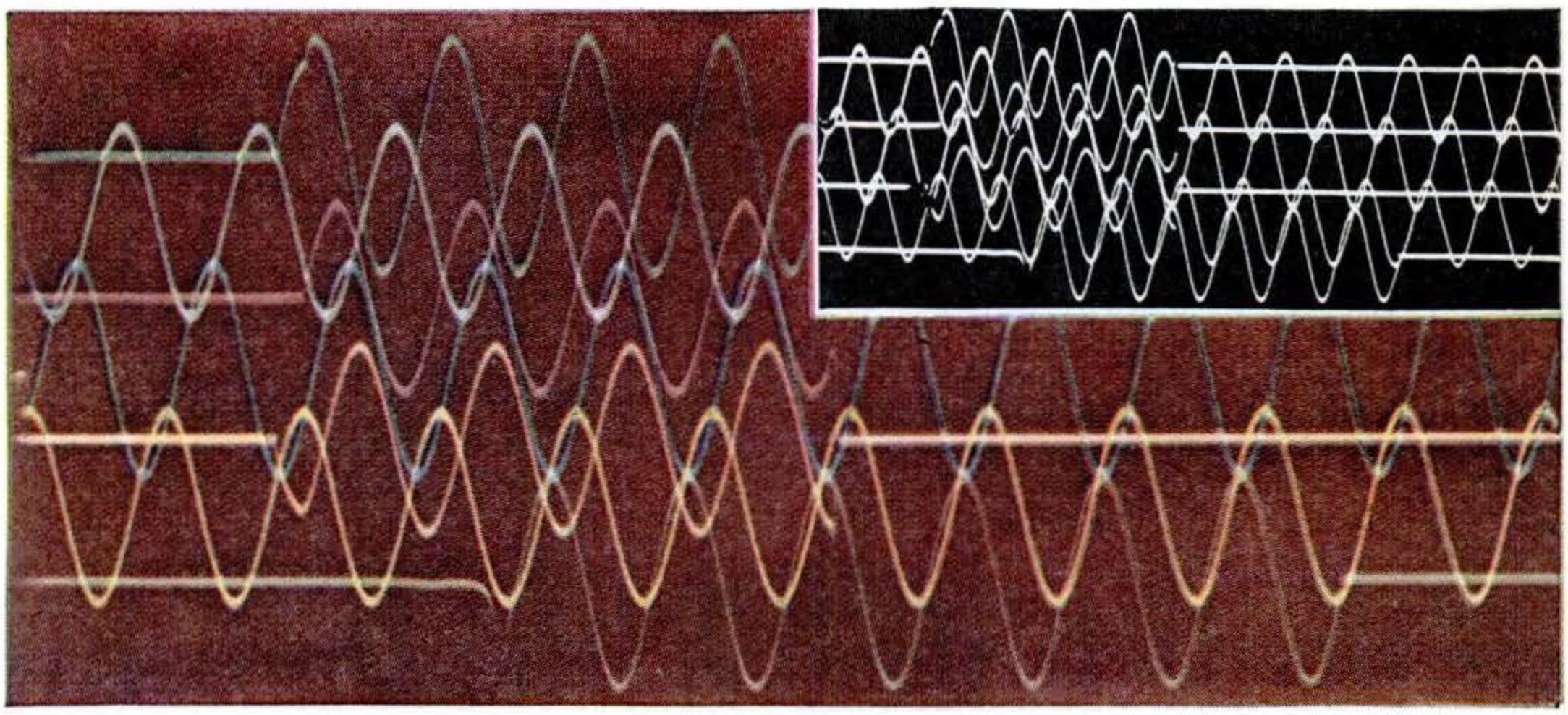
Long Hops Seem Shorter

You'll have little trouble whiling away the hours if you're one of the 80 passengers aboard Boeing's four-motored, 340-m.p.h. Stratocruiser. Large and luxurious, the main cabin (above) on the upper level of the big double-decker features full-reclining, foam-rubber seats for easy sitting, with plenty of leg room and aisle space. Then, to stretch your legs, you can stroll down to the swank cocktail lounge on the lower level. Here you can read, play cards, and, on some air lines, even get an in-between-meal snack. The long bulge under the wing (inset) outlines the lower lobe, used also for cargo.



Color Simplifies Chart

If you think the colorful maze of wavy lines on this seven-element oscillogram is complex, just try to unscramble the same lines on the one without color (inset). Westinghouse oscillographers, having the same trouble, collaborated with Ansco film experts on a method of photographing the wavy-line readings in color. By placing a filter of a different color in the path of each light beam before it strikes the moving film, as many as seven readings can be produced in separate colors at the same time. Then, to record the colored lines, color film is substituted for the usual black-and-white.

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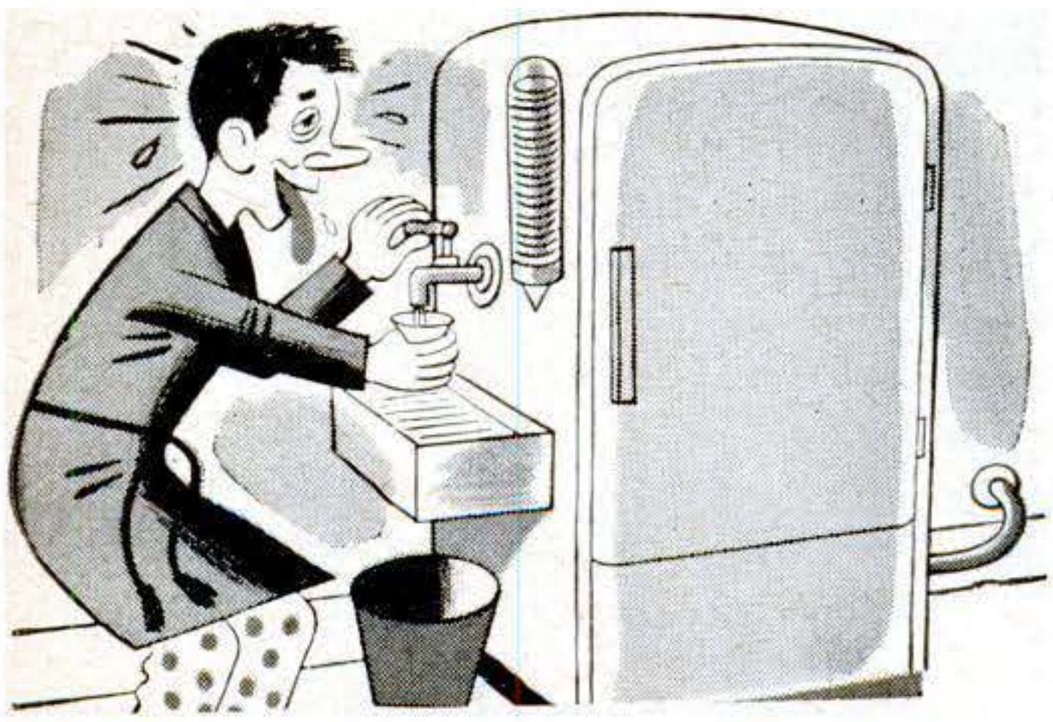
I'd like to see them make . . .

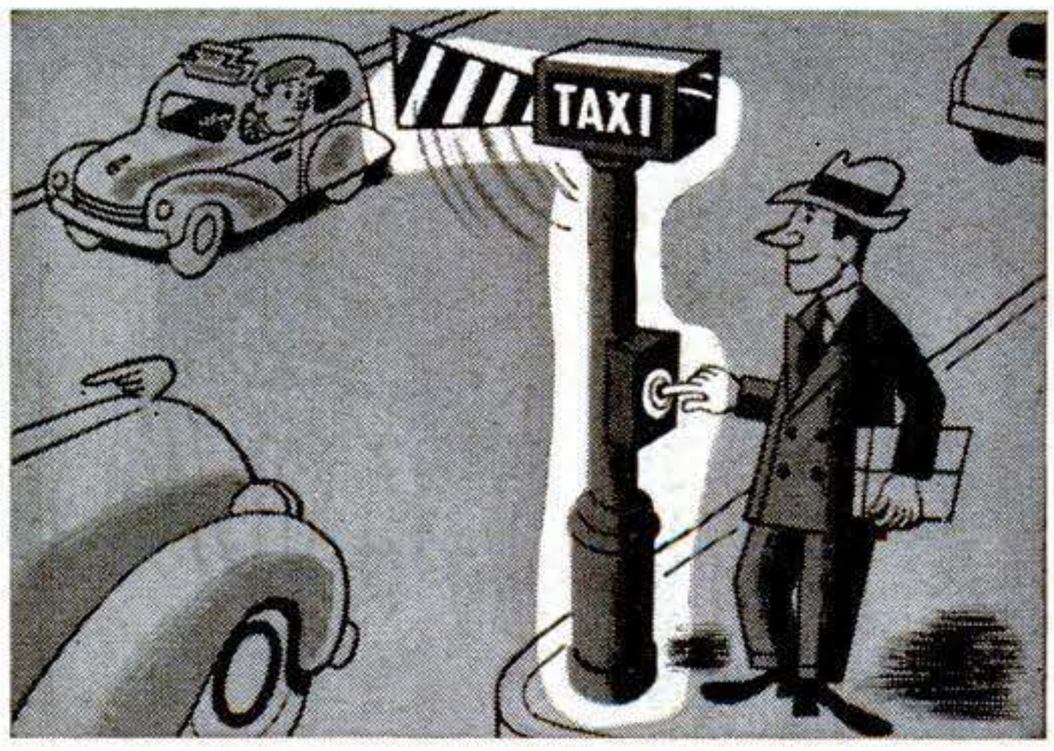
Cartoons by Syd Landi

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay $5.00 for every such suggestion that it accepts for publication. Contributions cannot be acknowledged or returned.

Push-Button Menus. They'd save you time and the waiter a lot of walking. Pressing the buttons would register your wants on a master panel in the kitchen and indicate your table.—A. W. HARGROVE.

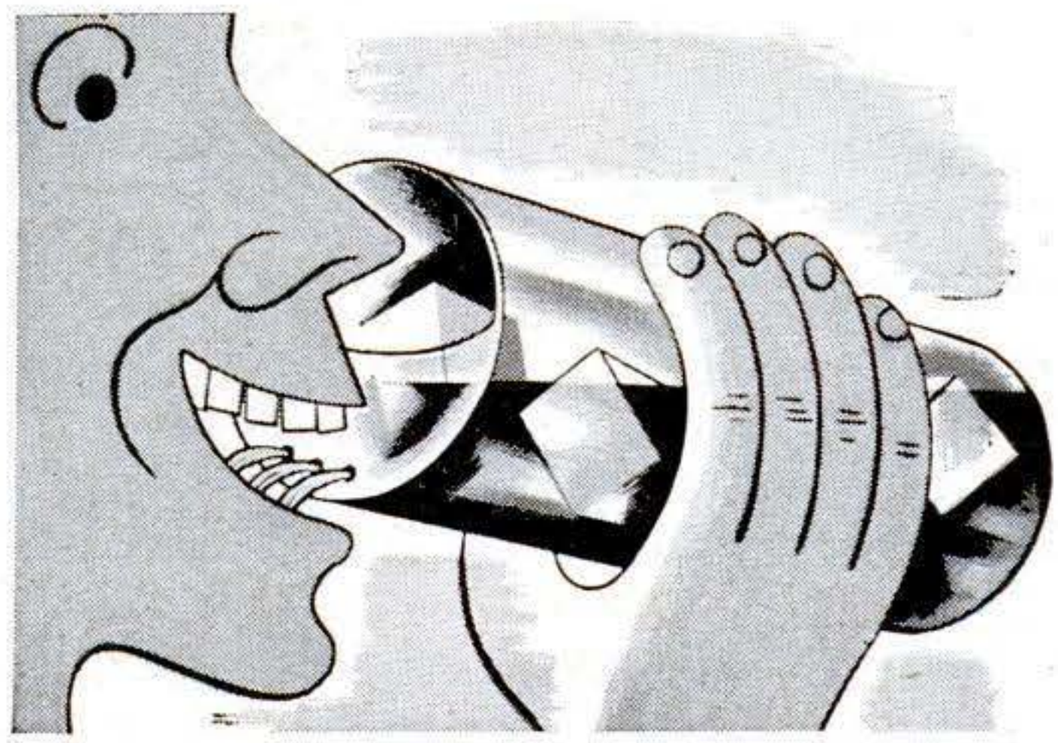


Refrigerator Water Tanks. If refrigerators had tanks into which water could be piped, you'd have a steady supply of ice water. A faucet on one side would make it easily available.—G. N. HOSACK.



A Signal to Call a Cab. Some sort of signal erected at busy street corners to hail a taxicab should please a lot of people, especially those unable to whistle or too dignified to yell.—F. M. FOX.

Drawer-Type Suitcases. If suitcases were designed to open like drawers, several could be stacked up and used between trips as a bedroom chest. It'd save storing the suitcases, too.—FLORA MURRAY.



Glasses with Ice Guards. A curved guard across the top of a drinking glass in the manner of an old mustache cup would help keep ice cubes in place while you are sipping a cold drink.—MRS. W. S. WILBUR.

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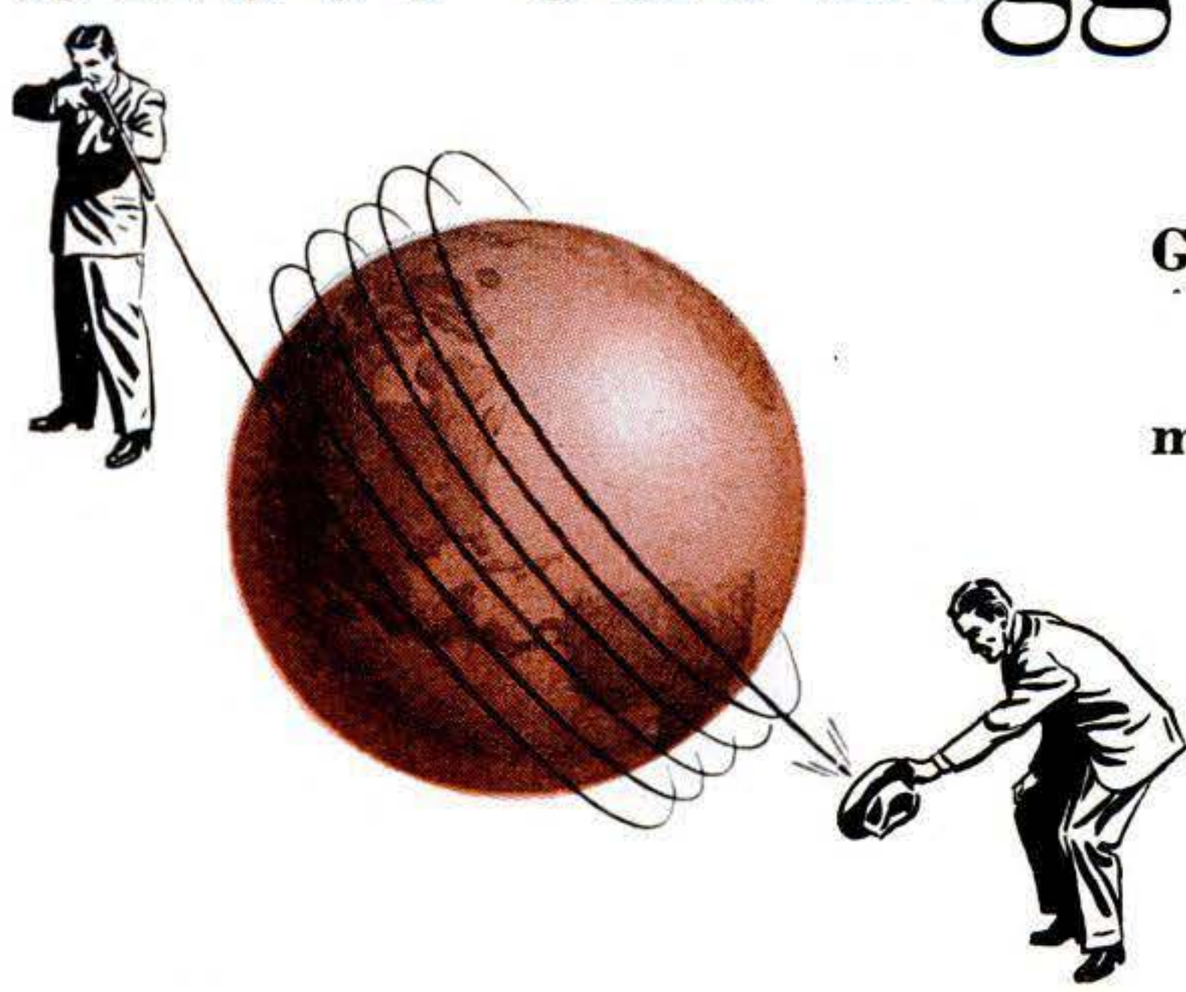
Can Huge New Atom Guns Shoot Out Biggest Secrets?



Gigantic ring-shaped machines, with 10-billion-electron-volt wallop, may transform energy into matter.

By Alden P. Armagnac

Drawings by Ray Pioch

SUPPOSE that a bullet could be fired 150,000 miles, six times the distance around the world. Suppose that it could be given a shove to speed it up every 150 yards. Suppose, too, that it could be so aimed and guided throughout this long, fast flight that it would hit a target no bigger than a man's hat. Now suppose, furthermore, that this bullet were something that no one had ever seen or ever could see.

The experimental physicists have quit supposing such things can be done. They know they can perform the very feat that you have just been asked to imagine. They are as sure of it as you are that two and two make four. They have the blueprints for guns that will impart such tremendous energy to such particles—and they expect to have at least one of the mammoth machines operating in about three years.

The energy that these machines impart to their projectiles is measured in electron volts. The synchro-cyclotron at the University of California, biggest atom gun in the world today, has a power of 200,000,000 electron volts. Now work has begun in England on the parts for a 1,500,000,000-electron-volt accelerator for the University of Birmingham. Two American machines will be even mightier. Both are designed to reach 10 billion electron volts, 50 times the power of the greatest in use today.

Dr. Ernest O. Lawrence, the inventor of the cyclotron, revealed the plans for one of these machines recently at the Sheffield centennial at Yale. It will be called a bevatron. (*Bev* signifies "*b*illion *e*lectron *v*olts" and *tron* is a Greek ending that means "the agency for.") An equally powerful machine, to be called a proton synchrotron because it will accelerate protons by synchronized electrical shoves, is on the drawing boards of the Brookhaven National Laboratory on Long Island.

How Scientists Study Atoms

What these machines will do is comparable to increasing the force of gravity. If you could make a pencil falling from your hand gain momentum fast enough to hit the floor like a sledge hammer, you would have done something similar to the trick the physicist performs with the help of cyclotrons, synchrotrons, and other acceler-

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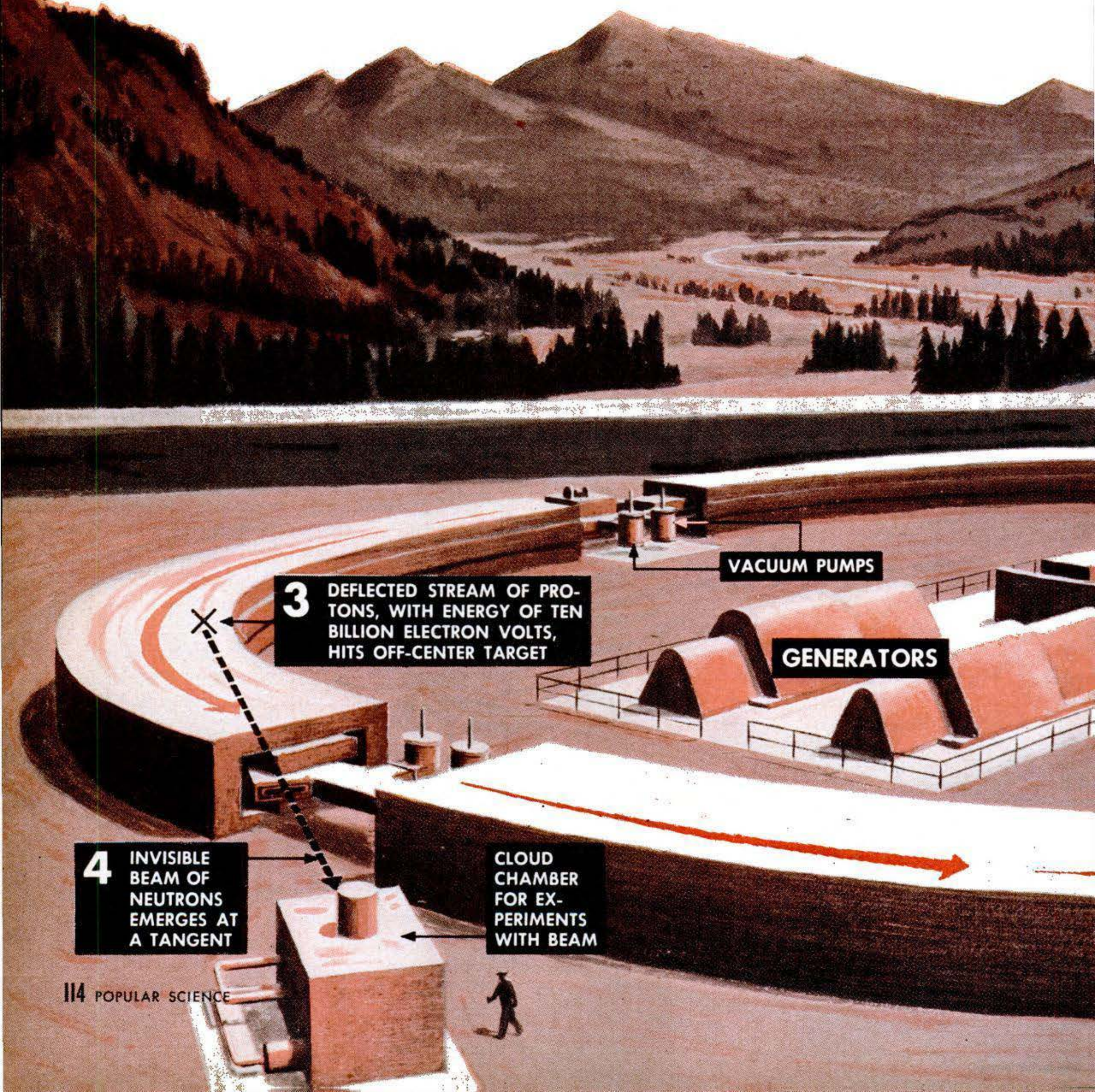
ators. He uses them to speed up atomic projectiles, with which he can then shatter other atoms, and he does it for exactly the same reason that a small boy socks an alarm clock with a hammer—to find out what's inside it and how it works.

Some of an atom's "innards," positively charged particles called protons, account for the difference between chemical elements. Their uncharged partners, the neutrons, account for the instability of some atoms and the stability of others. Hence these strange particles are extremely important in science, politics, and economics. Yet even those who put them to use, in atom bombs and radioactive "tracers," know no more about nature's bridles upon them than Columbus knew about America when he sailed westward in 1492.

Why do the physicists want more powerful atom smashers? They want to learn more, for one thing, about the mysterious glue or "binding energy" that holds charged particles like protons together, when by all the old rules they should fly apart. And they want to test their conviction that *energy* can be turned into *matter,* just as surely as atom bombs turn *matter* into *energy*.

The 10-billion-volt atom smashers projected independently by the University of California and the Brookhaven National Laboratory will work on the same principle. The key feature of each, in which they differ



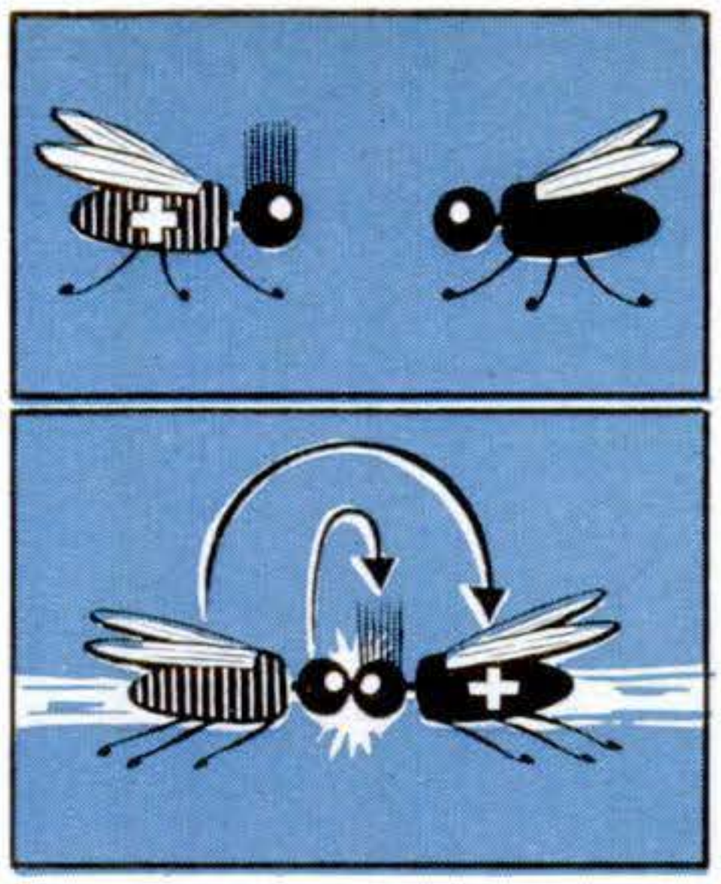
from today's biggest machines, will be a gigantic ring-shaped magnet. Like the fence that keeps horses within a race track, the ring magnet will restrain atomic particles to a circular orbit, enabling them to be accelerated to fantastic speed and energy within a vacuum tube of practicable length.

The atomic projectiles will be obtained by stripping the electrons from atoms of hydrogen. This can be done by discharging an electric arc in hydrogen gas. Protons, the charged cores of hydrogen atoms, are left.

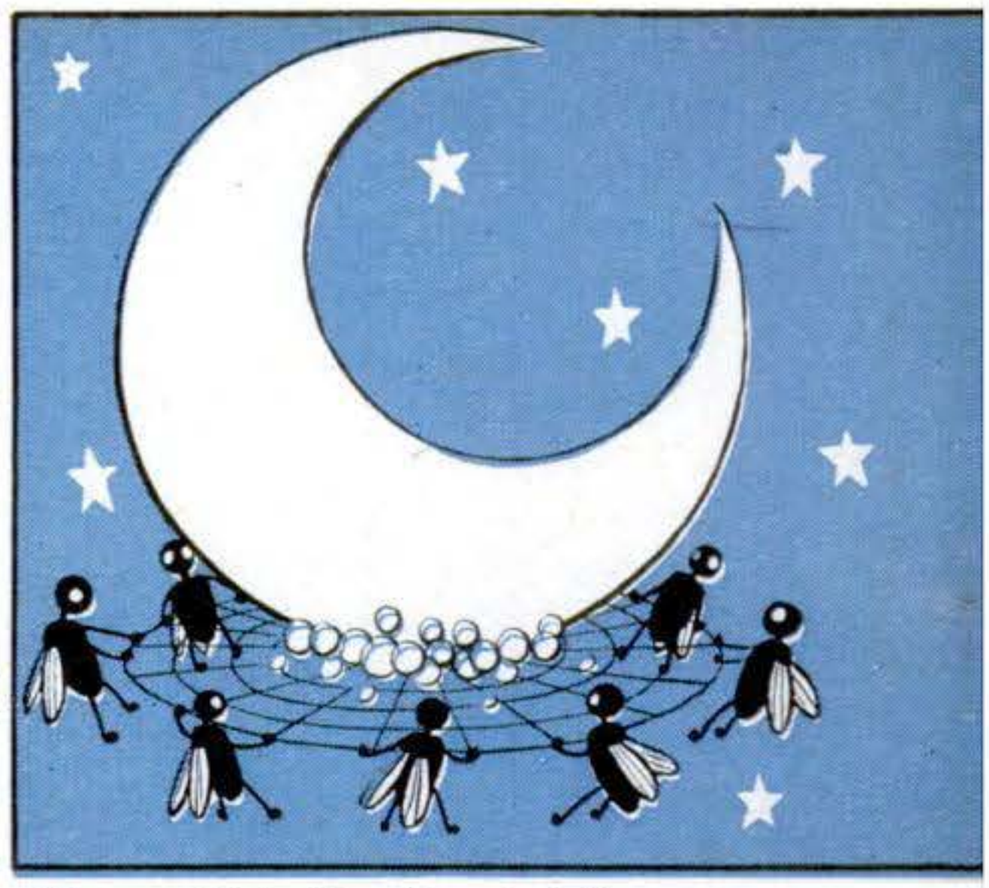
These protons will be catapulted into a "doughnut" or circular vacuum tube built into the ring magnet. The device that gives the protons a running start will be a 4,000-000-volt electrostatic machine called a Van

THE MIGHTY BEVATRON, 10-billion-electron-volt atom smasher, will be 50 times as powerful as today's biggest. To give clear view of construction, drawing omits all-weather housing. Giant ring magnet, most prominent feature of machine, holds atomic particles on a circular course so they can be boosted to fantastic speed and energy within a vacuum tube of practicable length. Arrangement shown is for experimenting with beam of neutrons, produced by collision of racing protons with metal target. Other particles available for experiment may include man-made mesons like those produced by cosmic rays, and the high-speed protons themselves. Hills encircling proposed location in valley will shield surrounding territory from dangerous rays.

Enlarge an atom to the size of the Capitol at Washington, and its nucleus would still be no larger than a fly. Projectiles used by atom smashers are fragments of the nuclei of atoms.



If hair vanished from one fly and sprouted on another when they collided, it would be no more fantastic than recent discovery that a proton can yield its "plus" charge to a neutron.



Forces "binding" or holding together such particles within the atom are tremendous. If there were such forces between soap bubbles, a thin layer of bubbles would support weight of moon.

de Graaff generator—a formidable atom-smashing tool itself—or a small cyclotron.

Zooming around the circular racecourse, the protons will gain speed at every revolution, as they get an electrical kick from a cylindrical metal electrode in their path.

Finally, when they have reached full speed, the protons will be deflected and will strike a target. Some of them will knock other particles, such as neutrons, out of the atoms in the target. The dislodged particles will fly into a cloud chamber where they will knock still other particles around, leaving visible tracks on photographic plates, which will show what has happened.

How Design Was Chosen

Choice of a design using a ring magnet follows consideration—and discard—of two possible alternatives, a "linear accelerator" and a cyclotron.

All three types are alike in using successive boosts from electrodes to speed up particles flying through a vacuum chamber. They differ in the shape of the path they impart to the particles. In a linear accelerator this path is a beeline, and no magnet is needed. A cyclotron employs a magnet to bend the path into a relatively compact spiral; its magnet must have pole pieces at least as large as the spiral in area, so that the particles always travel between them. A synchrotron, the class to which the new billion-volt machines belong, employs a magnet to bend the particles' path into a circle instead of a spiral. The circular track is so much narrower than the spiral that a ring-shaped magnet, which suffices to enclose it, has only a fraction of the bulk of the magnet required for a cyclotron of comparable size and power.

Some time ago, Dr. Luis Alvarez, of the University of California, proposed to accelerate protons to unprecedented energy in a linear accelerator. The hitch was that, to get protons up to speeds equivalent to billions of volts, the tube would have to be at least half a mile long. In contrast, the experts calculate that a ring-shaped racecourse 160 feet in diameter, the size of the projected machines, will yield the aimed-at figure of 10,000,000,000 electron volts.

The ring-magnet design also hurdles the practical limit of power attainable by cyclotrons, which today have reached staggering dimensions and complexity. The magnet of the 4,000-ton California synchro-cyclotron, largest of existing atom smashers, weighs as much as 20 ordinary locomotives. Even Dr. Lawrence, who has been building such monsters for years, confesses he is sometimes bewildered by the maze of dials and switches on this machine's control panels. When they are properly juggled, the synchro-cyclotron emits a superpenetrating neutron beam that retains half its power after passing through nearly a foot of concrete or lead, and operators need 10 feet of concrete for protection. Workmen with steel-cleated shoes find their feet misbehaving when the powerful magnet is turned on. Yet this machine, whose particles whirl

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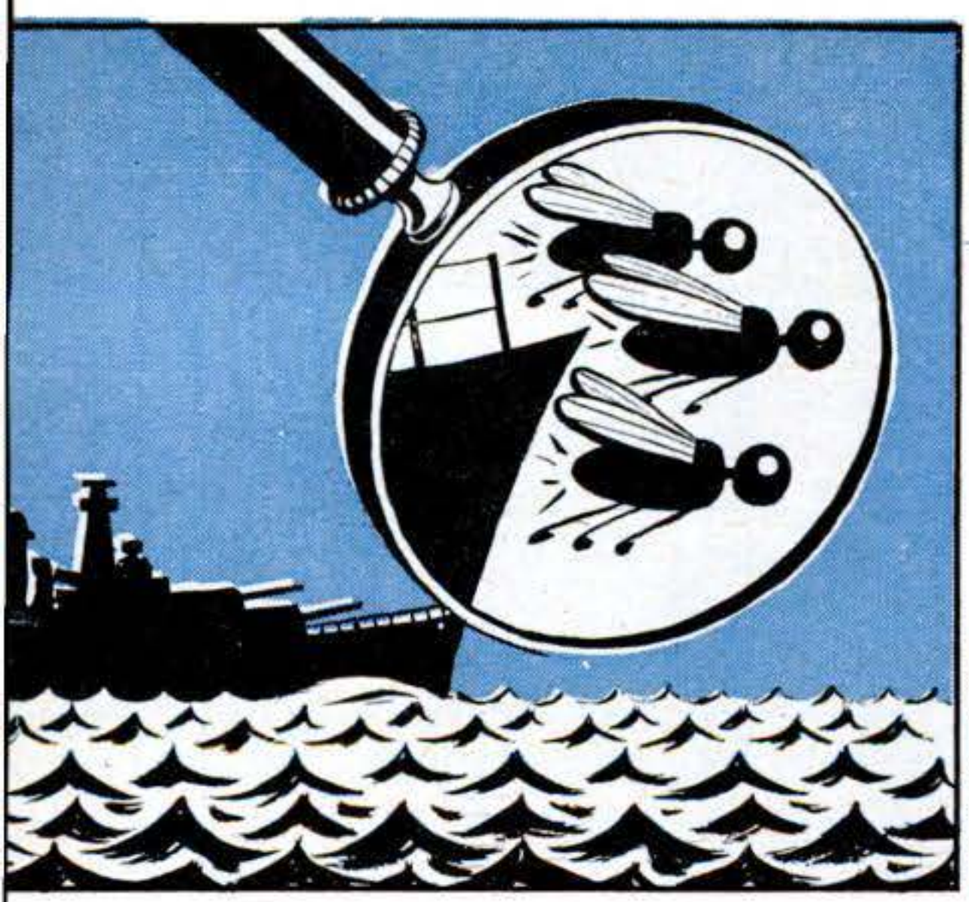

To impart enough energy to such particles to smash atoms with them, physicists need generators that will momentarily develop as much power as the engines that drive a battleship.

These particles will be guided by tremendous magnetic forces throughout the long course they travel while they are gaining sufficient speed to fulfill their mission as projectiles.

As these particles gain momentum, their mass will increase. This strange fact will have to be taken into account in timing the impulses of billion-electron-volt machines.

within a vacuum chamber of 184-*inch* diameter, will be a toy compared to the projected atomic race track of 160-*foot* diameter.

An attempt to "scale up" the design of a cyclotron to reach 10 billion electron volts would require a magnet with the colossal weight of 3,000,000 tons—an amount of metal that all the iron and steel plants in the United States would require nearly two weeks to produce. With only a slight twinkle in their eyes, Brookhaven scientists suggest that such a burden might sink Long Island.

Magnet to Weigh More than Cruiser

Actual plans call for something more within reason, a ring magnet about three times as heavy as the synchro-cyclotron's magnet. It will still be a sizable chunk of iron. Its estimated weight, 12,000 to 13,000 tons, exceeds that of a heavy cruiser!

As the speed of atomic particles approaches the speed of light, they tend to lag behind regularly timed electrical impulses, because they become heavier with increasing velocity. Fortunately a new principle shows how to overcome this tendency by giving pulsations of an alternating-current electrical circuit a correspondingly decreasing frequency, so that they will always be correctly timed to make the particles continue gaining speed. Called "the principle of phase stability," the idea was incorporated in the California synchro-cyclotron, and will also help the new machines to develop their enormous power.

How nearly the rival California and Brookhaven groups have arrived at the same design for a 10-billion-electron-volt machine, even to almost identical dimensions, indicates the soundness of its theory. Preliminary engineering designs shown to the writer differ only in such details as arrangements for access to the "doughnut," a vacuum tube of ceramic or other material about a foot by four feet in cross section, which will be placed between the magnet poles.

William M. Brobeck, the bevatron designer, plans a magnet with four circular quadrants. Between each pair of these will be a straightaway section where the vacuum tube will be accessible for pumping. The design favored by Dr. M. Stanley Livingston of the Brookhaven National Laboratory, in which a perfectly circular magnet can be used, uses a magnet of C-shaped cross section that does not completely enclose the tube. Vacuum pumps and experimental apparatus can therefore be connected to the tube all the way around its circumference.

Listening to one of these mighty machines in action, from a vantage point behind a sufficient thickness of protective shielding, you would hear an eerie symphony of sound. First the whine of great generators coming up to speed will rise to a high-pitched crescendo. Then, as their entire output is virtually short-circuited through the magnet coils, the pitch of the sound will drop abruptly like that of a plane in a power dive. At that moment, as much power will surge from the generators as it takes to run a 35,000-ton battleship at top speed. Such

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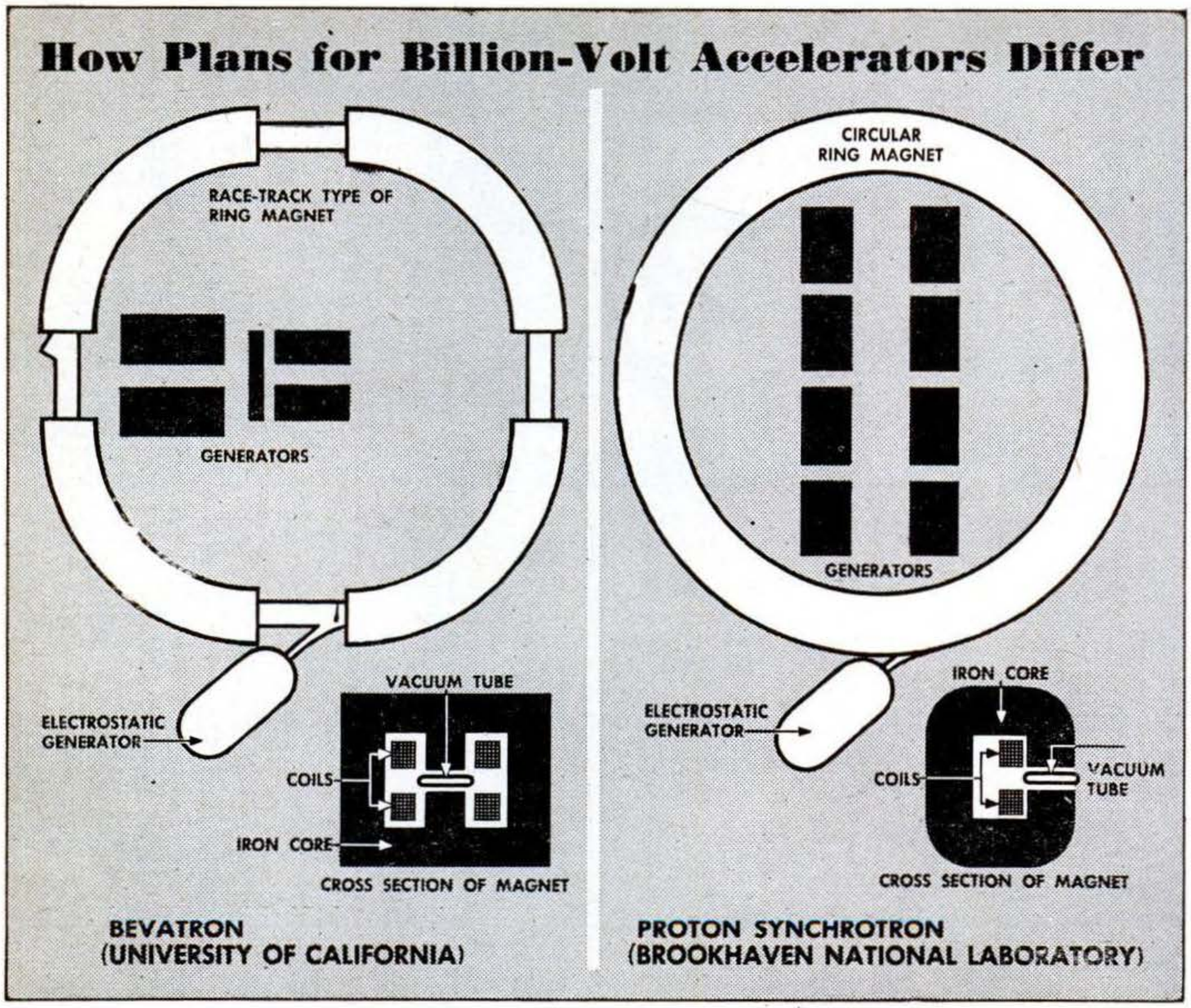

Bevatron and proton synchrotron both will propel protons in vacuum tube between poles of 160-foot ring magnet, but provide different ways of making connections to tube. Straight-away sections between quadrants provide access in University of California design. Brookhaven design, using C-shaped magnet core, exposes vacuum tube all the way around the circle.

a discharge of electricity, required to keep the protons on their course, will take place at intervals of a minute, or less. The mechanical shock will be a brutal one, requiring special reinforcement in the anchorage of the magnet and generators.

Flywheels on the generator shafts will keep them turning despite the braking effect of this jolt. Provision will also be made to feed the stored energy of the magnet back into the flywheels, and thus harness the back surge of power from the magnet coils, by using the generators as motors during this part of the cycle. This must be done because so much energy is put into the magnetic field that no cooling system could handle it. It must be instantaneously withdrawn, or the conductors would vanish into pools of molten copper.

Streaking through the vacuum tube, the flying particles will circle it a couple of million times, receiving a boost from the electrode within the tube on each time around. Then the great magnet will "let go" of them and they will fly outward; or, alternately, its pull may be momentarily increased to deflect them inward.

That's when the nuclear bullets will hit the target, a wedge-shaped piece of metal inserted through the wall of the "doughnut."

What happens then will be front-page news.

For the first time, scientists will command a beam comparable in power to the cosmic rays that strike the earth's outer atmosphere. These rays are known to create mysterious particles called mesons, larger than electrons and smaller than protons, whose role in atomic structure is little understood. With the superpower atom smashers, physicists aspire to manufacture mesons themselves, and bare their secrets. It should take only a billion electron volts or so.

And at their full power of ten billion

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volts, the men at the controls may fulfill their dream of turning energy into matter. Collision of the speeding particles with the target, they hope, will produce more protons than existed before. Then they will actually be turning kilowatt hours into something as tangible as hydrogen or helium!

By progressing from the transmutation of atoms to the transmutation, and even creation, of subatomic particles, the scientific adventurers hope to discover the underlying laws of the atom's nucleus.

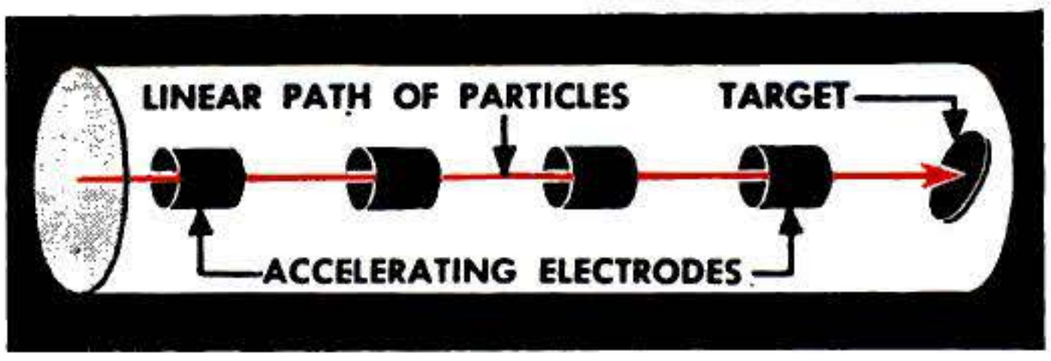
Neutrons and protons are very curious animals. Werner Heisenberg, the physicist who headed Germany's atomic-bomb project, suggested several years ago that when a neutron collided with a proton, they might exchange identities. In other words, the neutron might become a proton, and the proton a neutron, in about 1/1,000,000,000,000,000,000,000 of a second. Million-electron-volt particles of the California synchrocyclotron proved Heisenberg was correct.

Billion-electron-volt beams of the bevatron and proton synchrotron may reveal still stranger things. It is entirely possible that a reaction in which little atoms unite to form a big one may yield energy on a grander scale than does the fission reaction of the atom bomb, in which a big atom splits into little ones.

Much more remains to be learned about the core of the atom before such techniques can be used in bombs or power plants. Recent advances in technical skill have far outdistanced progress in learning the basic facts about the atom's nucleus. Now the theorists, in their turn, hope to catch up.

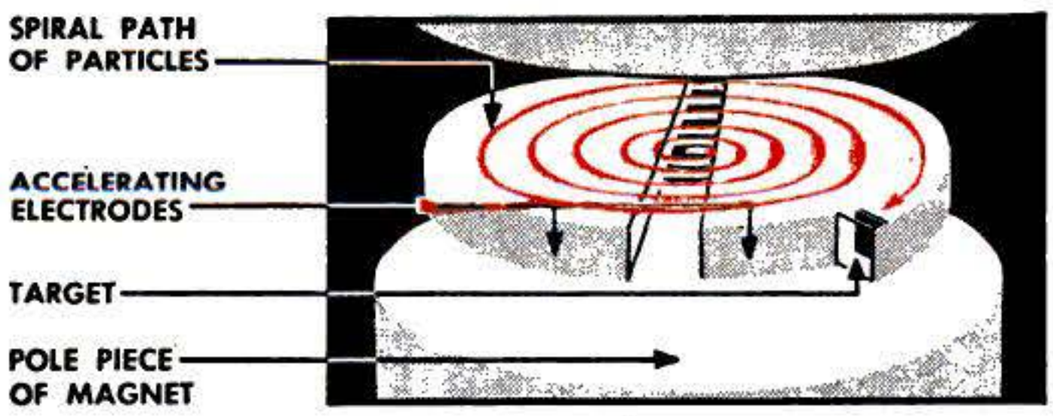
Engineers estimate that it will cost about $15,000,000 to build a 10-billion-electron-volt accelerator. The need for the knowledge it should yield is so urgent that scientists are confident that the funds will be forthcoming. END

Today's Line-Up of Atom Smashers



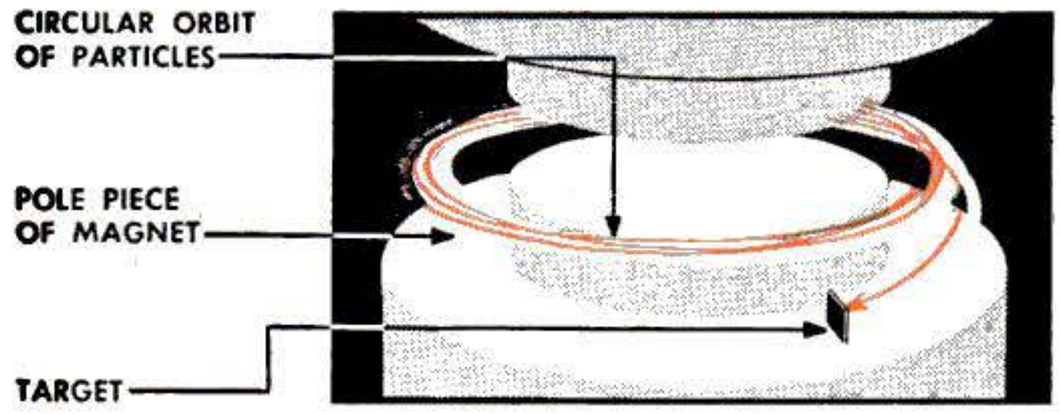
Linear accelerator. A straight vacuum tube, with accelerating electrodes at intervals, in which all types of charged particles travel along a straightaway path.

Van de Graaff generator. A static machine using moving belts of silk or paper to build up a potential of millions of volts. It may contain a built-in tube of the linear-accelerator type, as when used as an injector for feeding particles into other accelerators.

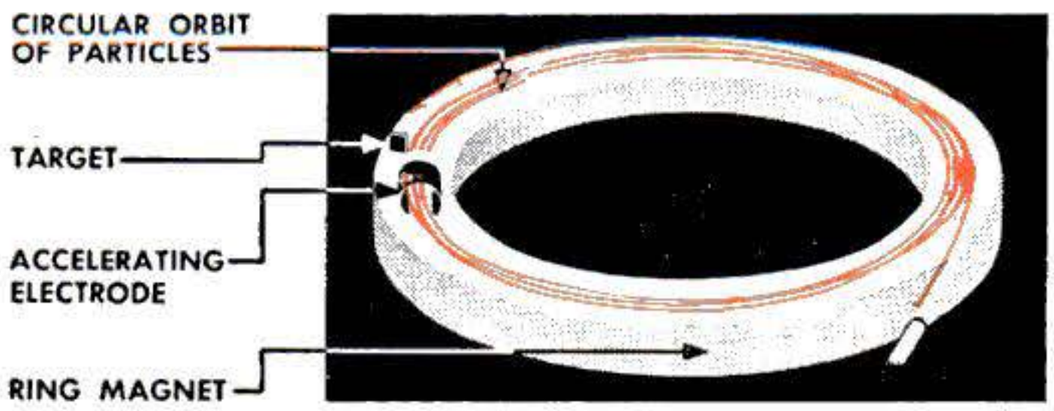


Cyclotron. An accelerator for protons, deuterons, or alpha particles, in which they follow a spiral path from a source, at the center, to a target at the outer edge of a vacuum chamber between the pole pieces of an electromagnet. Particles are accelerated by one or two D-shaped electrodes.

Synchro-Cyclotron. A form of cyclotron in which the frequency of pulses to electrodes is not constant, but varies so as to keep in step with the motion of particles of extremely high energy. This is necessary because of the particles' change in mass due to relativity.



Betatron. An accelerator for electrons, in which they follow a circular orbit in a doughnut tube between the pole pieces of an electromagnet and are accelerated by the transformer action of the flux within the orbit. On being released and striking a target, the speeding electrons give rise to a beam of X-rays.



Synchrotron. An accelerator for electrons or protons, in which they follow a circular orbit within a doughnut tube, and are accelerated by an electrode. The tube may be enclosed in a ring-type magnet. On being released and striking a target, these particles produce all types of nuclear radiation.

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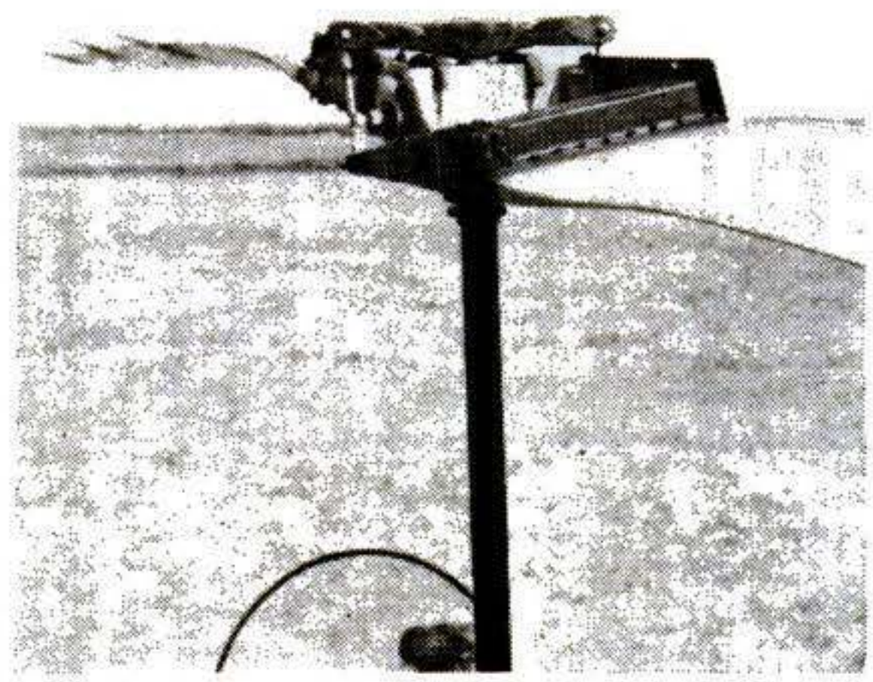
What's New in Aviation

Mooring Made Easy. This self-propelled pontoon dock extends a laborsaving welcome to Navy seaplane pilots. Pushed along a 600-foot submerged cable by modified Sea Mule power units, the dock moves out from shore, then swings in any direction so that an incoming plane doesn't have to maneuver crosswind. Finally, it centers the plane in the berth with nudges by water jets, three on each side. Partly inflated tires soak up any bumps. With only 18 inches of freeboard for a mooring job (above), the pontoons can be raised like a dry dock (at right) for emergency plane repairs.



Balance Steers 'Copter. The Seibel helicopter has a movable cabin: It slides backward, forward, and sideways to control direction of flight by changing the center of gravity. Shown with an outrigger gear that will be removed after testing, the craft is said to have only half as many machine parts as a conventional 'copter. Simplicity of its control system is illustrated by the two-blade rotor assembly, on the right.

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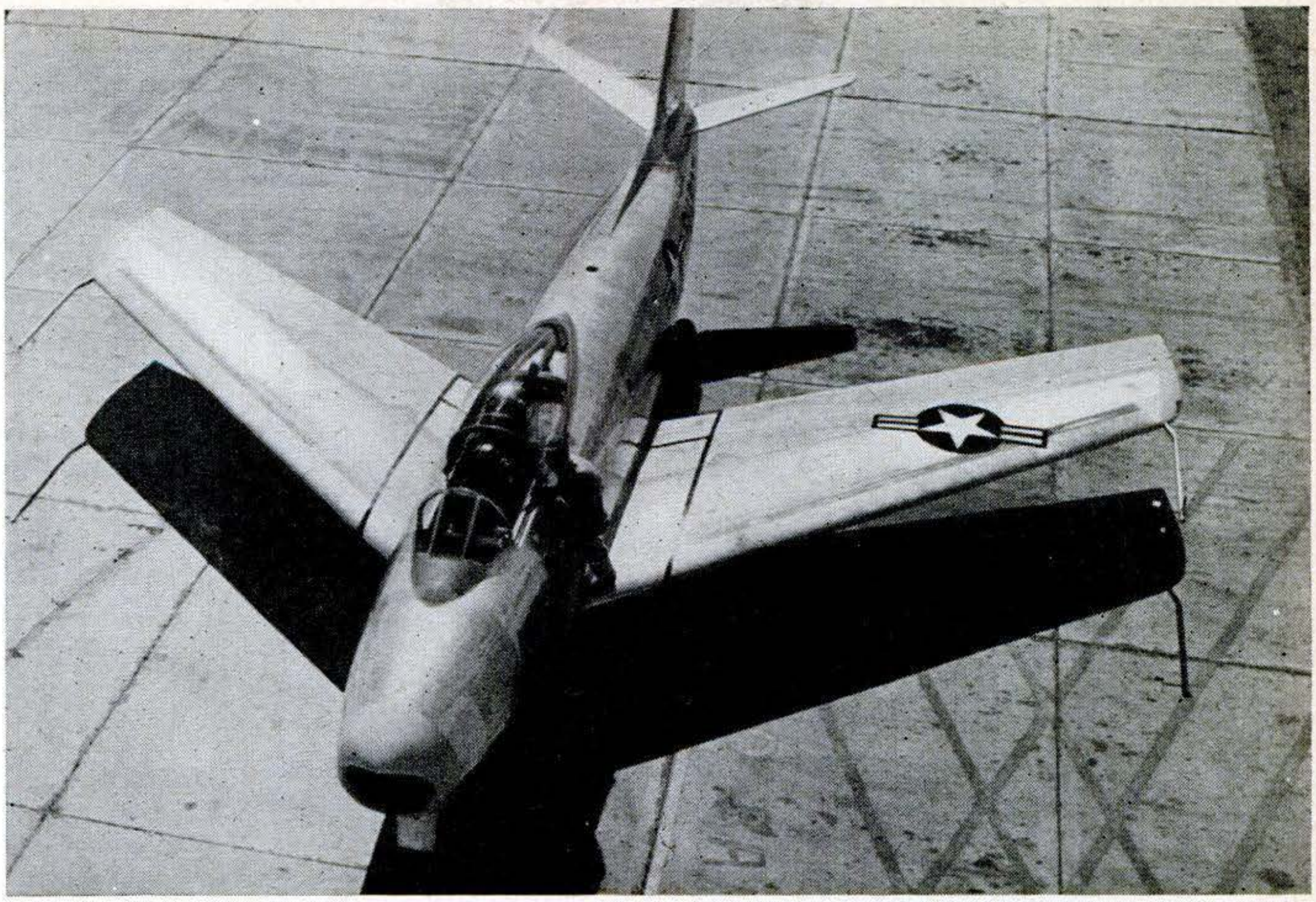
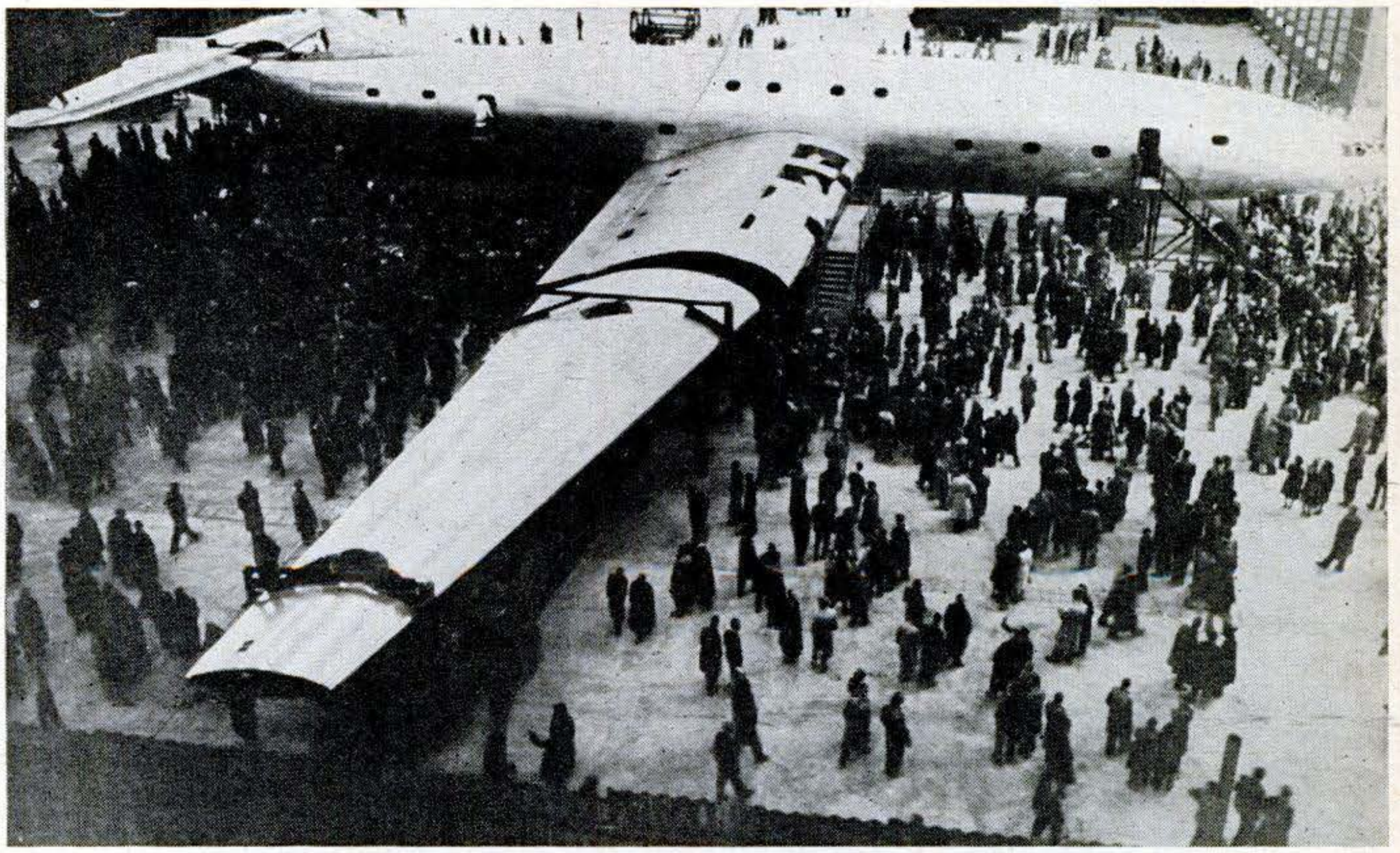


Swept-Back Fighter. The Air Force's latest candidate in the fighter field is the North American XP-86, a single-jet single-seater with sharply swept-back wings and tail surfaces. The plane's wing span and length are the same: 37 feet.



Britain's Biggest. Prototype for a fleet of nonstop transatlantic air liners, the Brabazon I is shown nearing completion in its special hangar at Bristol, England. With a span of 230 feet, it is designed to carry up to 120 passengers between London and New York at better than 300 m.p.h. The Brabazon I will have eight piston engines inside the wings turning four propellers; later versions will be powered by jets.

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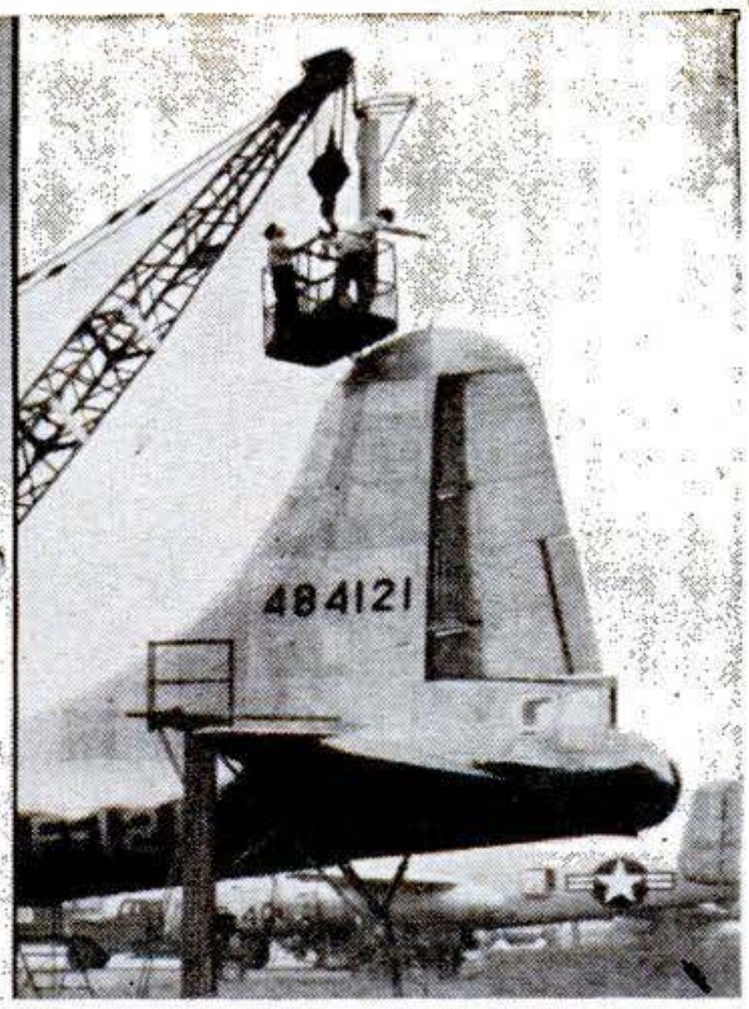
What's New in Aviation



A Radio Station That Flies. Those oversize antennas pictured above transform the B-29 that carries them into a high-altitude broadcasting station for FM and television. Modified by Martin engineers, the big bomber is testing the airborne relay system being developed by Westinghouse as a method of extending the range of high-frequency broadcasts (PSM, Nov. '45, p. 92). Circling at 30,000 feet, the plane picks up a ground station's signals (which travel in straight lines and are therefore limited by the horizon) and rebroadcasts them downward over a wide area. The 25-foot retractable mast under the nose is for transmission; the shorter tail antenna being installed at right, above, is for reception. In actual practice, a network of cruising planes would relay signals across the U. S., each one transmitting to the area below it and passing programs on to the other planes. Flush antennas will probably replace the projecting type when tests are complete.

Speeding Up Air Rescue. With five men climbing a 40-foot ladder simultaneously, this Piasecki HRP-1 shows off its rapid-rescue technique. Demonstration was part of Navy acceptance ceremony.

Hiding the Engines. Beechcraft's new Twin-Quad 20-passenger air liner has four engines to drive its two props, but they are completely submerged in the wing. The plane, now undergoing flight tests, is the first one of its size to try out the butterfly-style tail assembly introduced on the same company's smaller Bonanza.

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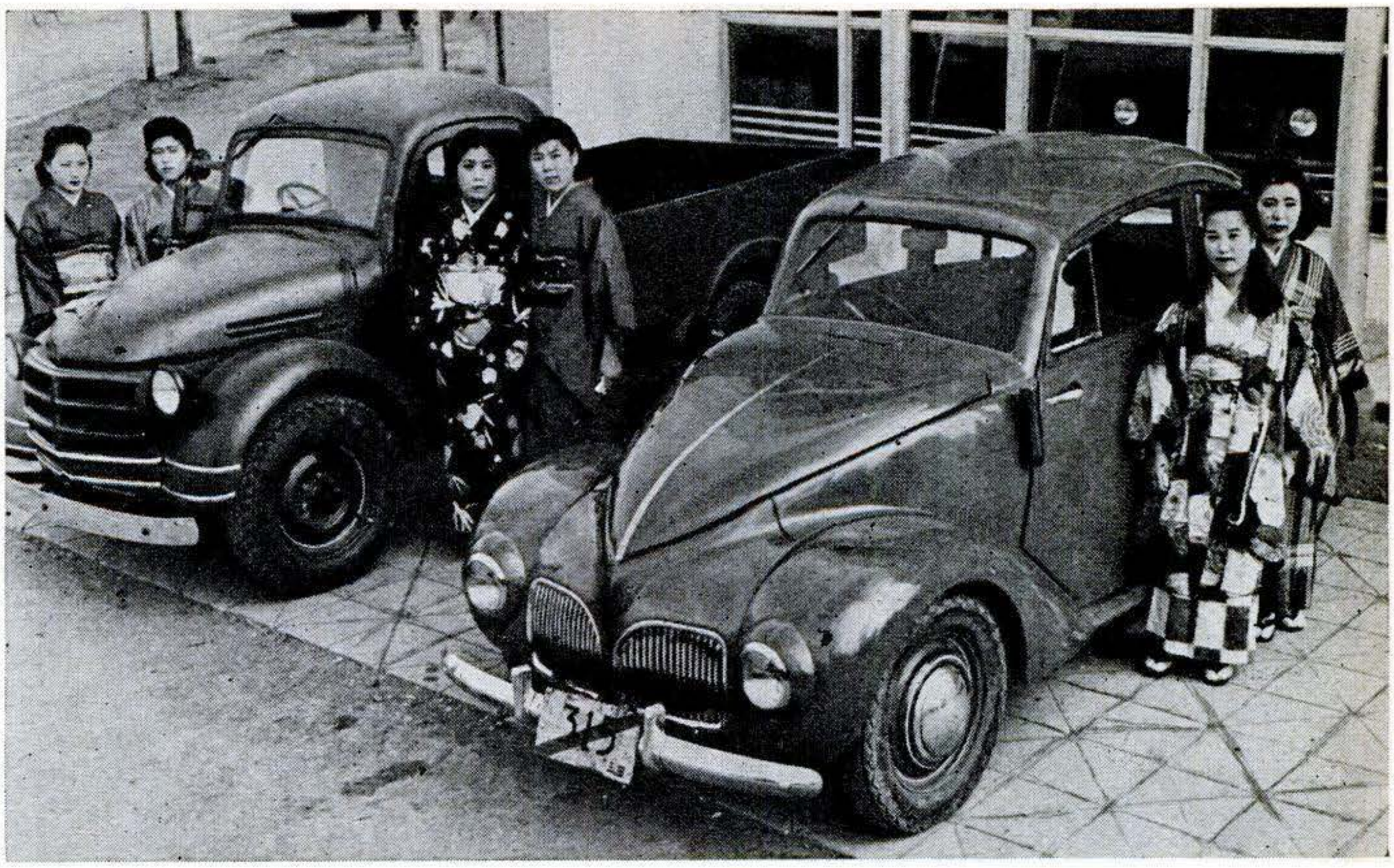


Jap Cars Shown

THESE first products of Japan's postwar automobile industry, recently displayed in Tokyo, don't mean that Nippon's citizens will abandon their walking habits. The entire output of the Toyota Motor Co., at Nagoya, is only some 30 cars and 200 trucks a month. These will be sold to hospitals, to government agencies, and to business firms.

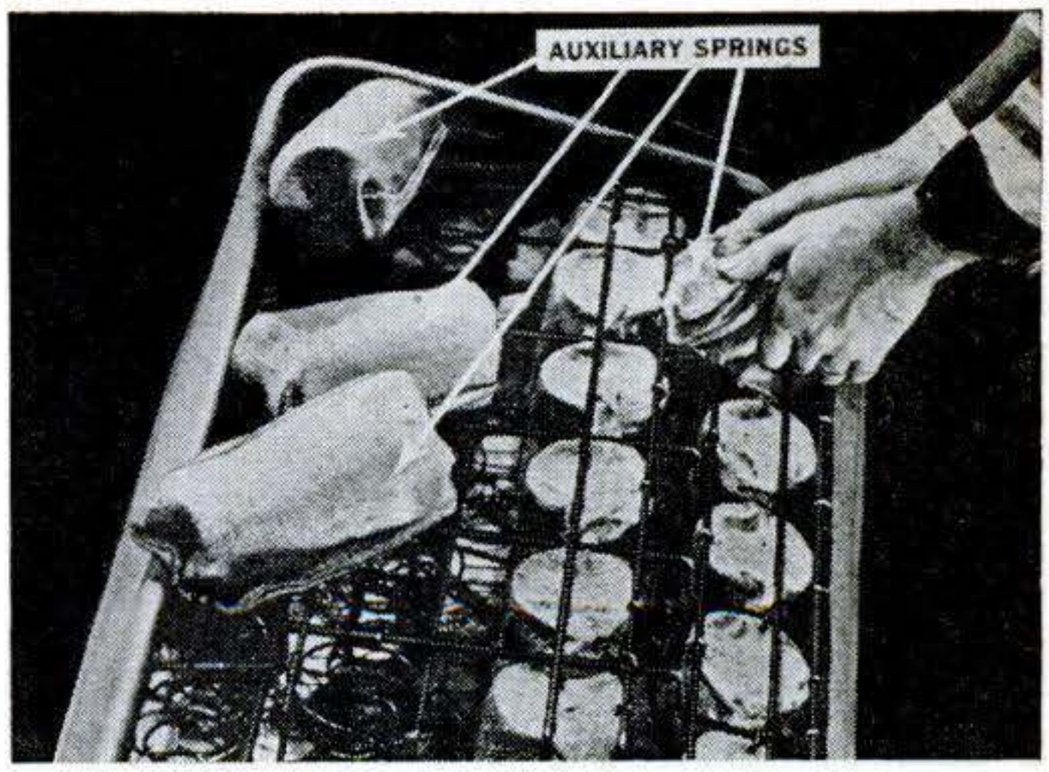
The passenger car, seating four, has a 27-hp., four-cylinder engine, a speed of 54 m.p.h., and will average 40 miles to the gallon. The one-half-ton trucks have the same power plant, but a different gear ratio and will do about 30 miles on a gallon. The cars will sell for 250,000 yen ($5,000), and the trucks for the equivalent of $3,200.

Busting Paper Bags

TO MEASURE how much a paper bag can take before bursting, Union Bag & Paper Corp., laboratories use glycerin to inflate a rubber diaphragm against an anchored sample of paper. The pressure required to break the paper is recorded on a dial.

Gas Plays Vocal Tricks

YOU and your hearers will burst out laughing at the sound of your voice, which becomes a nasal falsetto, immediately after a few breaths of a helium-oxygen mixture. Extreme thinness of the "synthetic air" used by deep-sea divers and more recently by tunnelers (PSM., Sept., '47, p. 82) makes vocal cavities act as if they were less than half normal size, correspondingly raising the frequencies to which they respond. The effect is as ludicrous as the distorted images that a person sees in a fun-house mirror.



Seat Fitted to Driver

IF YOU'RE a bit on the heavy side and sink down uncomfortably in the driver's seat, take heart. Individually wrapped auxiliary coil springs, inserted between conventional spring seats as shown above, make each seat a custom-built job. Developed by Studebaker, these seat stiffeners add selective comfort to 1948 models.

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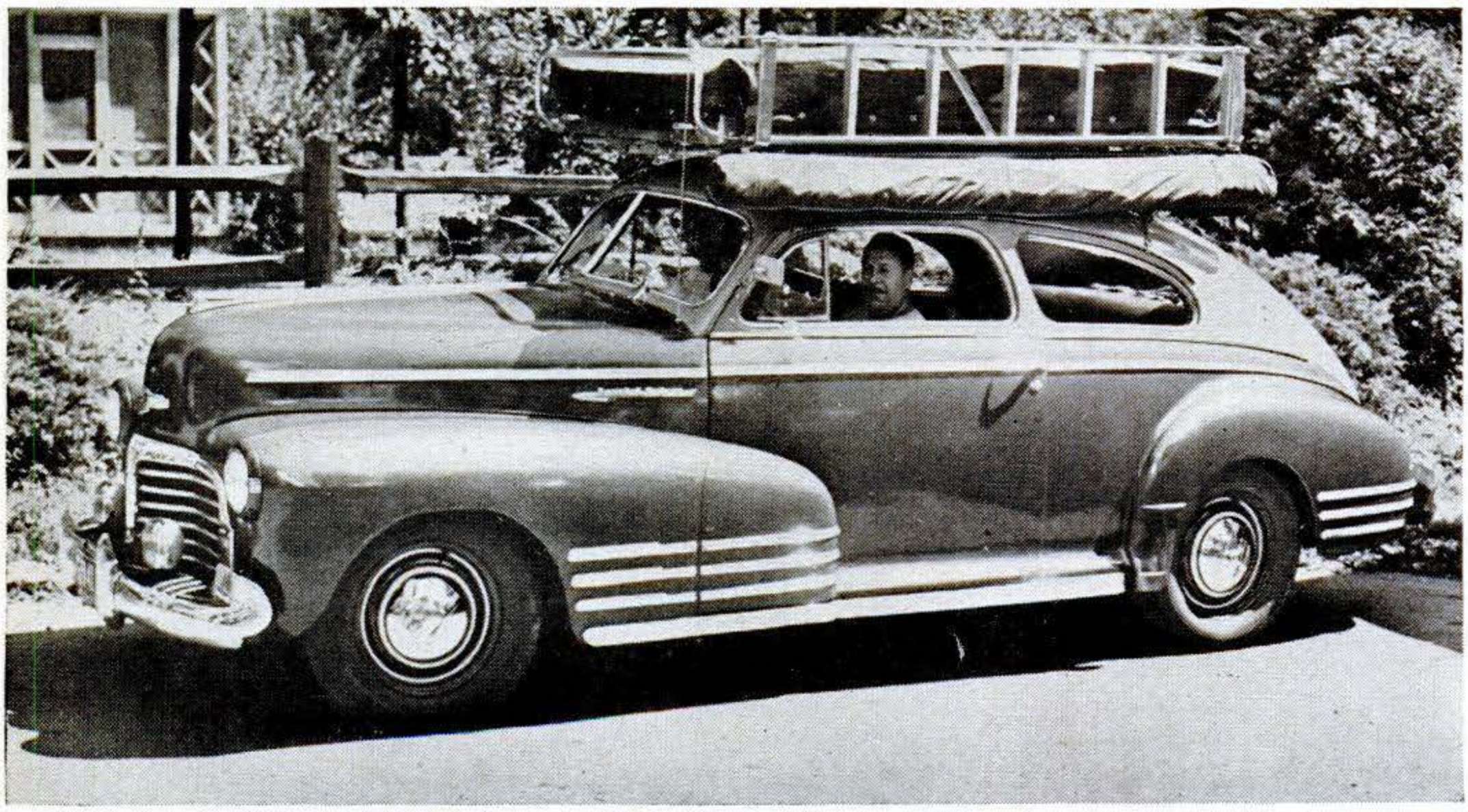
A small aluminum ladder gives access to snug sleeping quarters. Screened windows have flaps that can be let down in case of rain.

Car Top Makes Cozy Bedroom

PICK up your bed and ride, is the advice of Don Cast, of Columbus, Ohio, inventor of the collapsible, carborne bedroom shown here, which he calls a "Carbaña." Folded for traveling, a canvas enclosure four feet high is opened up by tugs on two strategic straps. Six suction standards around the sides of the metal car top support the 6½- by 4-foot bed. Truck drivers will be glad to hear that Mr. Cast has plans for a smaller model that will fit on top of a truck cab. No doubt, he'll get around to designing an outsize version for big families.

Awning makes an outdoor living room for the Cast's "Carbaña." Upstairs bedroom has two side-by-side air-inflated mattresses.



Entire sleeping unit weighs only 150 lb., and is anchored to a car-top luggage-carrier base.

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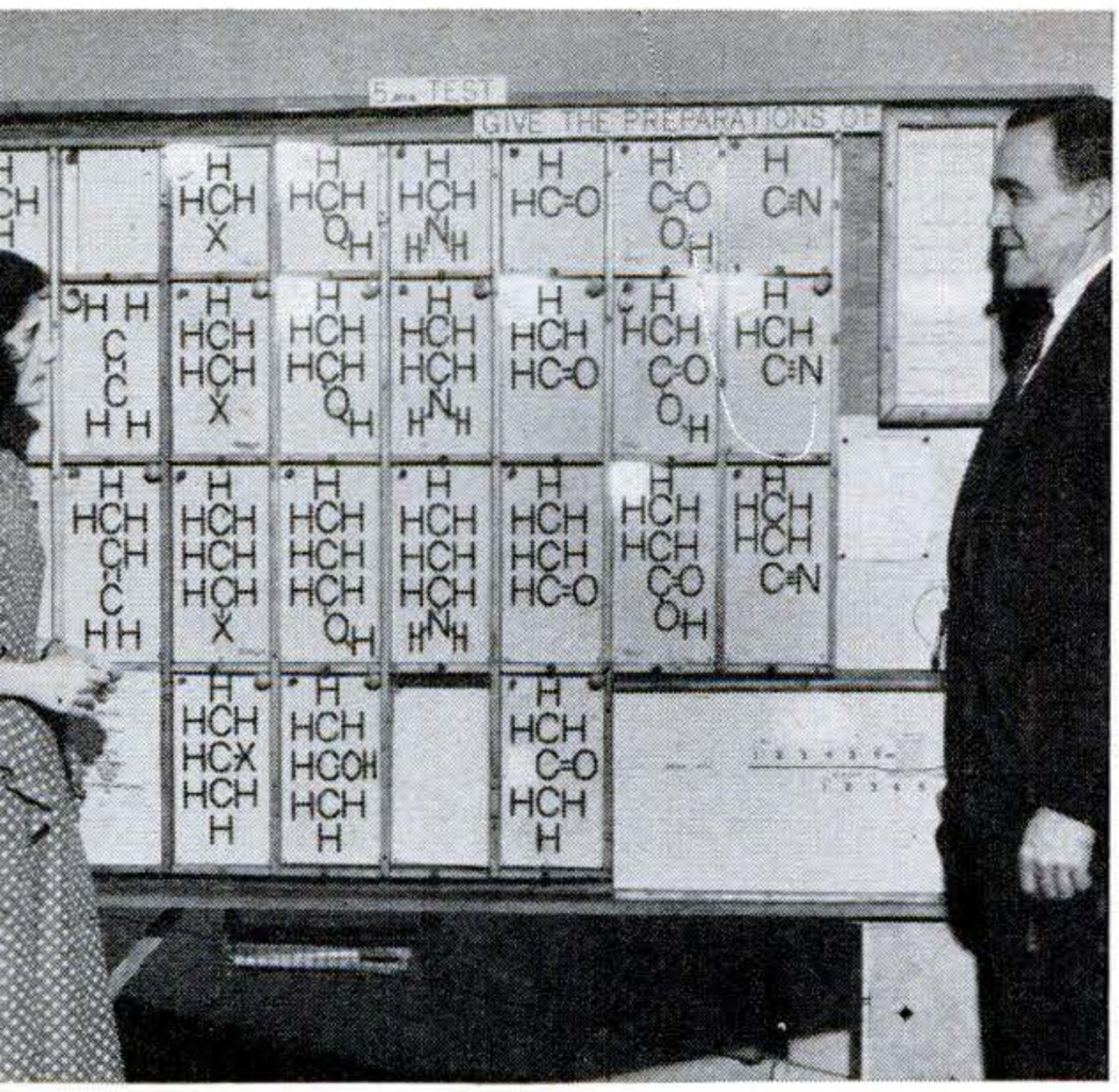

A boon both to students and instructor, the chart was devised by Dr. Richard Burns (at right, above), of Hunter's chemistry department, to take the tedium out of drill and review.

Chart Quizzes Students

STUDENTS at Hunter College, New York City, can test their knowledge of organic chemistry by simply poking push-buttons and watching lights flash the results. It's all done on a homemade, electrically operated chart fashioned from odd parts of old pinball machines.

To operate the test chart, the student first chooses one of the 11 classes of compounds listed in the upper right-hand corner. He then attempts, by pushing buttons under the formulas of basic carbon compounds, to select the proper ones from which a typical example of the desired class can be prepared. Small bulbs in the upper left-hand corners of the formulas light up when the choices are correct. An illuminated scoreboard in the lower right-hand corner of the six-foot-wide, four-foot-high panel keeps a running tally of right and wrong answers. At end of test, the student can learn the correct answers by turning a crank that lights up the ones he's missed.

Phone Aid Frees Hands

THE busy executive can now carry on conversations over the telephone without even lifting a finger to hold it. With the Jordaphone (PSM, Oct. '45, p. 96), a wartime development of the Jordanoff Corp., he need only transfer the phone from its regular cradle to the special one in the top of the instrument. Here the incoming voice is picked up directly from the phone's earpiece and amplified through a loudspeaker, eliminating actual wire connections. An ordinary microphone, placed anywhere in the room, transmits the outgoing voice to the mouthpiece.

In addition to freeing the user's hands, the device permits group conferences by telephone without individual sets (at right, above). An automatic volume control tunes down voices near the microphone and amplifies those at a distance. The 30-inch-high, foot-square console (at left) plugs into any 110-volt outlet.

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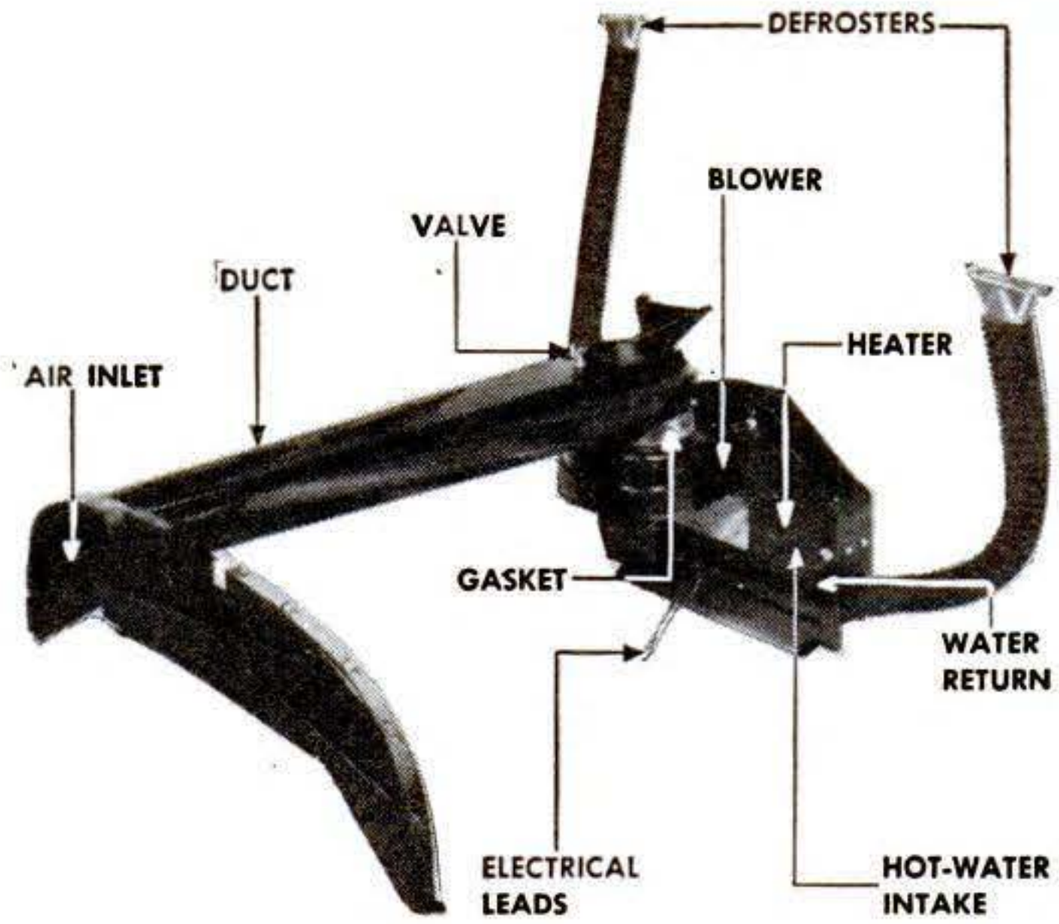
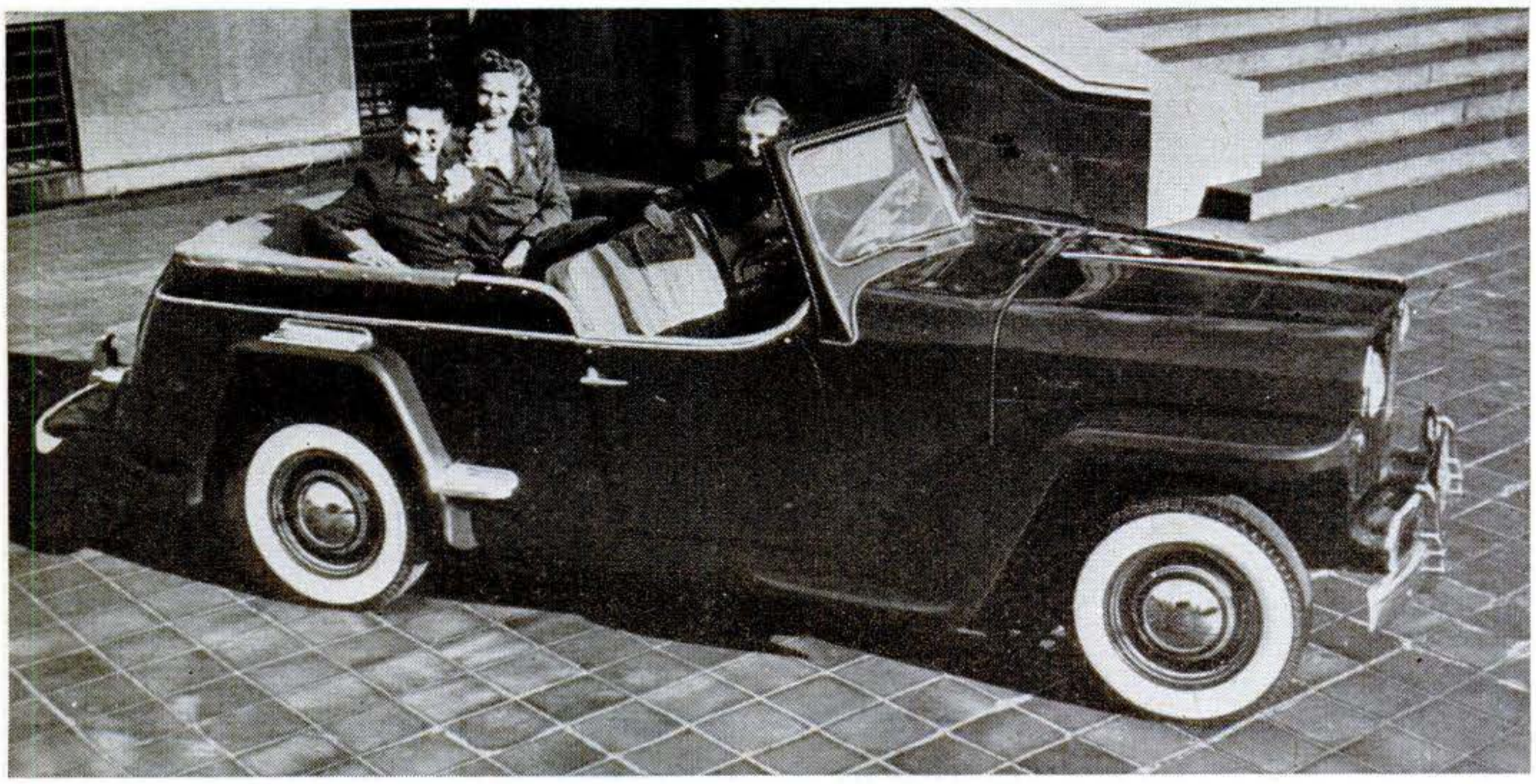


"Air Conditions" Cars

You can have a constant supply of fresh air in your car even with all windows closed and the heater on, if you have this new Ford unit. The ventilator-heater shown above scoops fresh air through the front grille, heats it with hot-water coils, and delivers it to the car's interior. The constant flow of fresh air reduces excessive humidity, making the passengers more comfortable and eliminating window fogging.

As long as your car is moving at a fair speed, the inlet scoops up plenty of air and forces it through the heater. When heat is desired at low speeds or when the car is standing still, a fan is switched on. In summer the heater unit can be cut out and the fresh air sent directly to the passengers.

The regular ventilators ahead of the windshield have been retained, for unlike similar systems built into some higher-priced cars, the Ford device is an accessory. It also differs from built-in types by having one instead of two air ducts. **As seen at left,** the Ford single duct is attached to the underside of the hood and separates from the blower unit when the hood is raised.



Jeep in Fancy Dress

Here is a racy new sports version of the jeep that Willys-Overland plans to put out this spring in the low-price class. Painted a fire-wagon red with cream trim and a gray convertible top, it is mounted on the 104-inch wheelbase chassis of the jeep station wagon. It has a standard four-cylinder jeep engine and front end, and is equipped with a high-speed gear ratio. Side curtains are used to close the car in bad weather.

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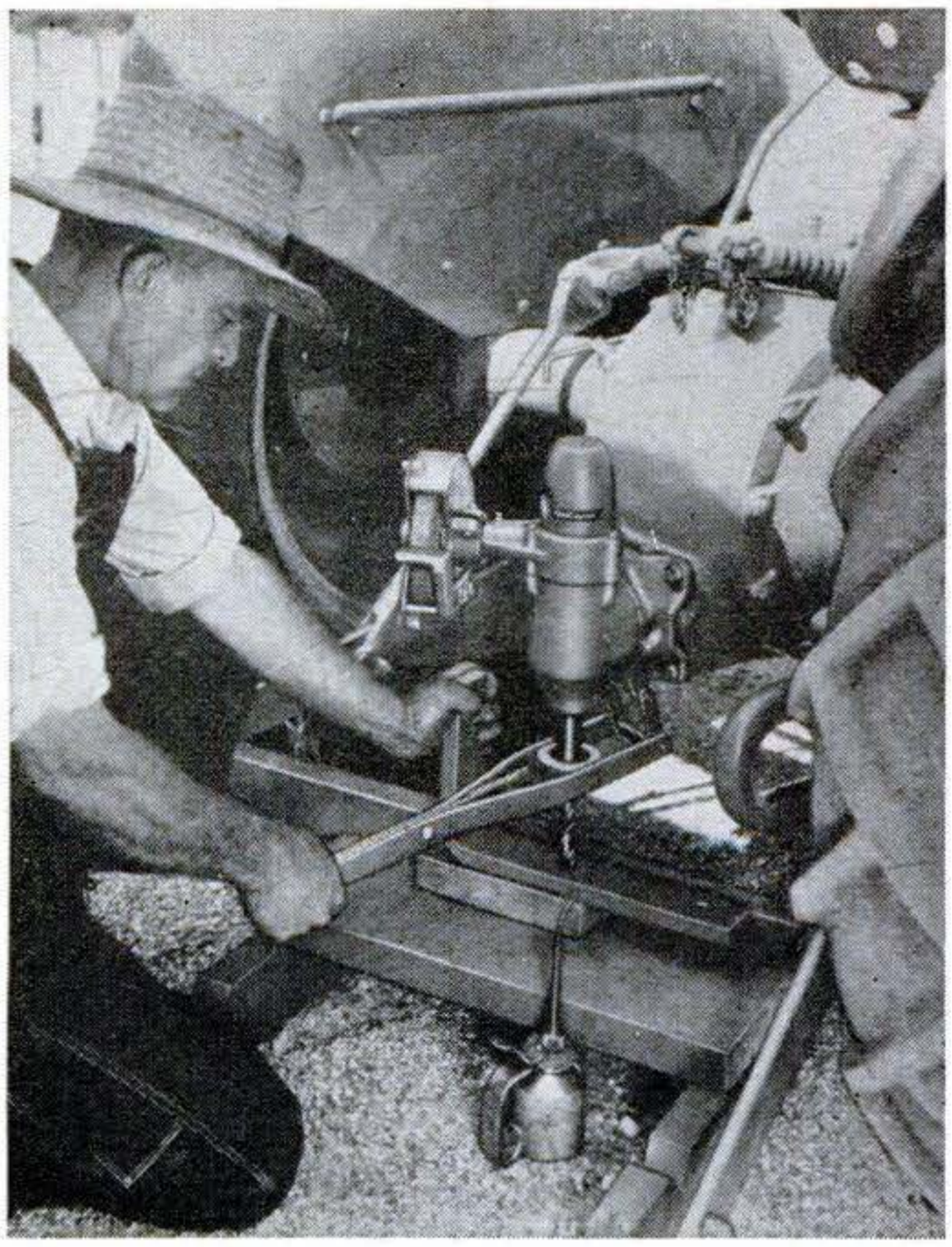
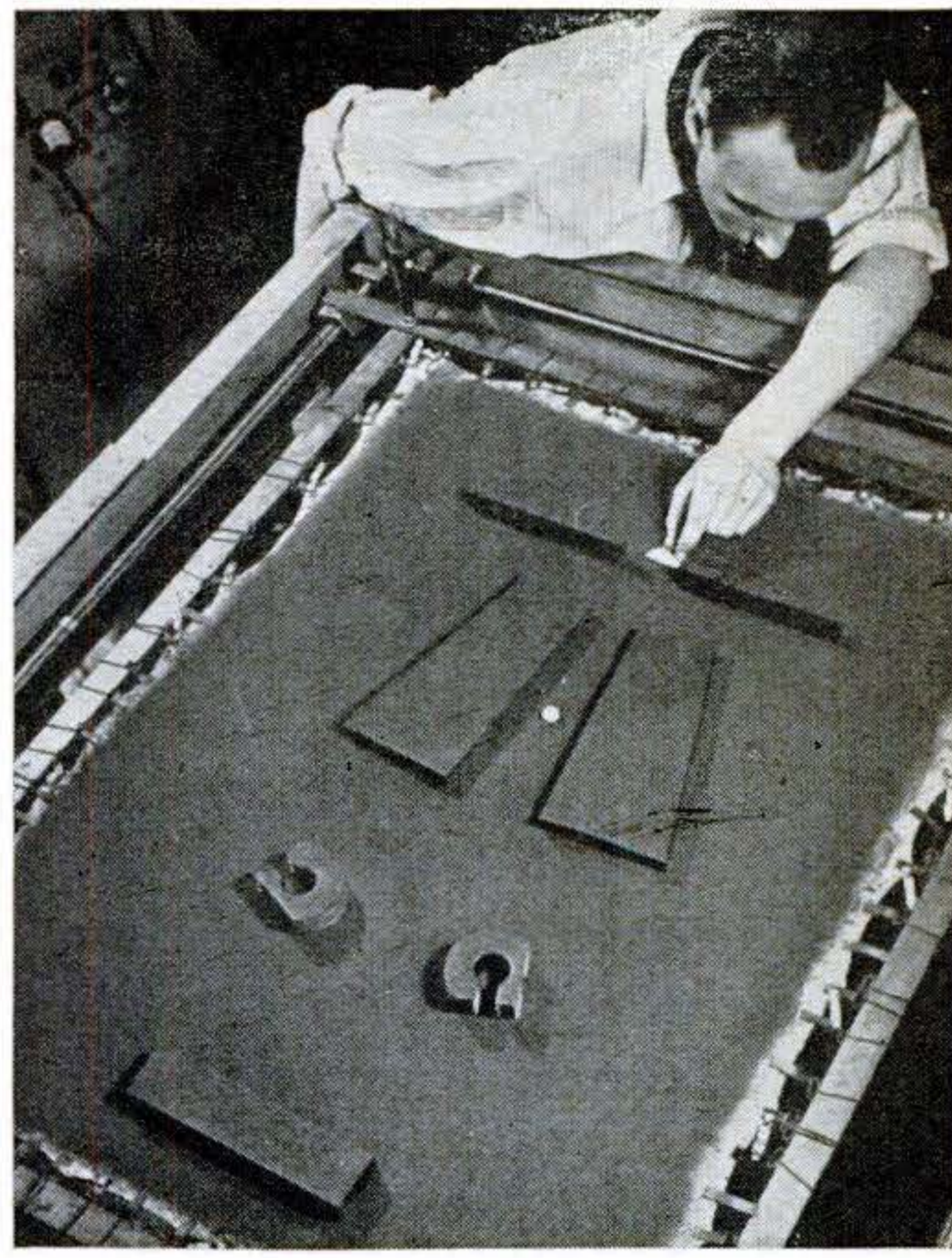


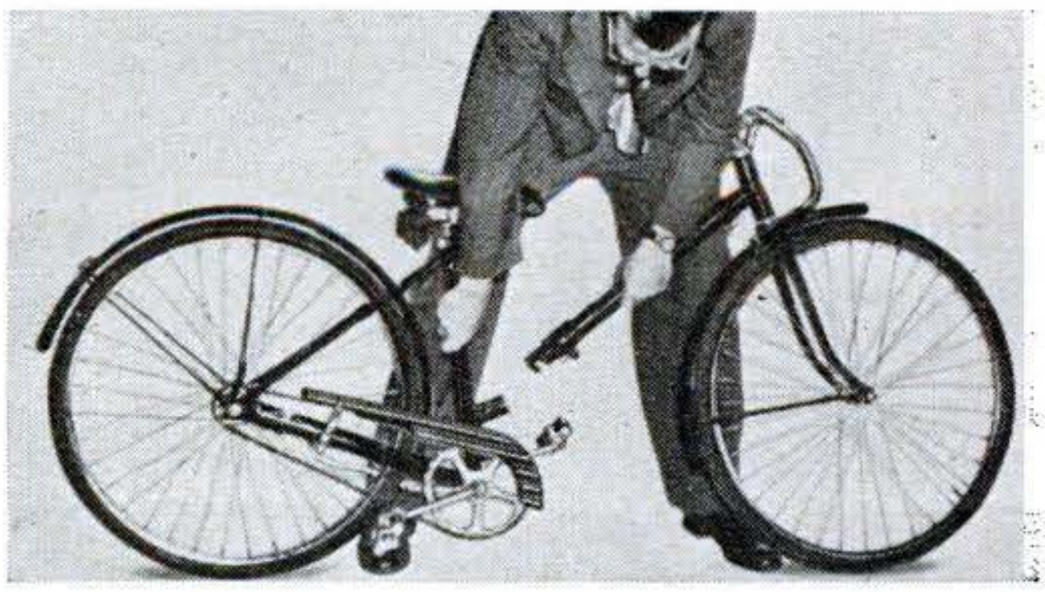
Tractor In Dual Role

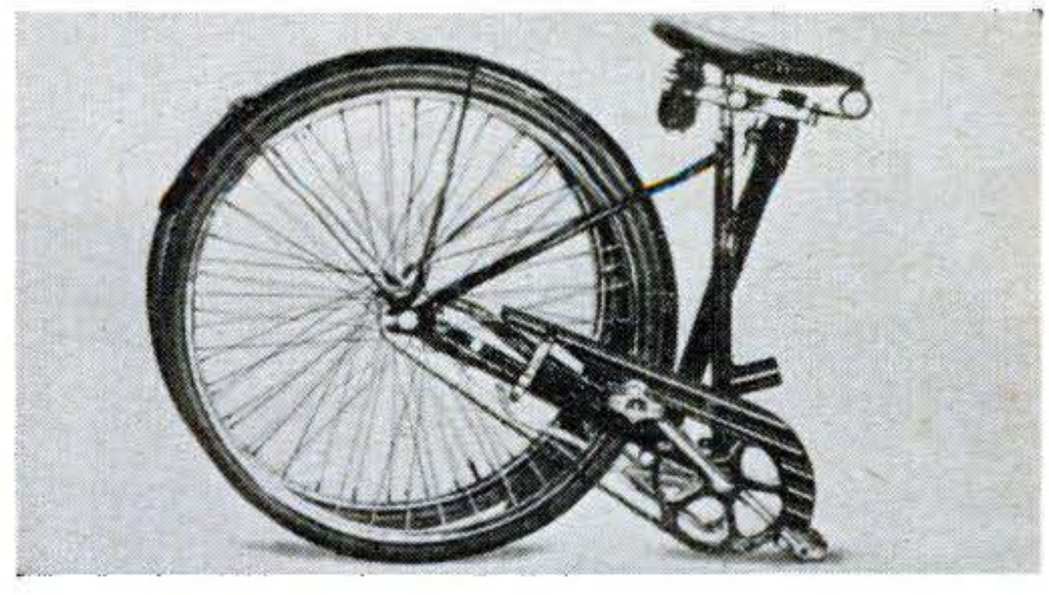
EVERY tractor becomes a "machine shop on wheels" when equipped with a new "fix-it" unit called the Farmcrafter. By merely harnessing the power of his tractor, the farmer can make on-the-spot repairs—like the drilling job above—and keep his tools sharp without having to hold up work while he goes back to the barn. Made by Sherman Products, of Royal Oak, Mich., the Farmcrafter offers a pretty complete setup. It provides the farmer with a grinder, a drill press, high-speed drills, plus a shaft that takes a variety of standard attachments.



Pin Ball Apes Electron

THIS rubber-mat obstacle course is a make-believe television tube—and the white marble is a stand-in for an electron. When Westinghouse engineers roll the ball—usually bronze—down the course, peaks and valleys simulate electrical voltage, while wooden obstacles represent grids and electrodes. Together they guide the "electron," slowing it down or speeding it up. By rearranging the course so the ball rolls the way they want it to, engineers can find the most efficient design for a tube—and do it in a day instead of the usual three months.





Bicycle Built In Two

CYCLISTS can now stow their bikes in the baggage compartment of their cars, or take them aboard train, boat, or plane with the ease of a traveling bag. Used by paratroopers during the war, the Columbia Compax folding bicycle is now in production at Westfield, Mass., for general sale. A standard-size bicycle, it can be taken apart in a few seconds without tools; even the handle bars fold up for convenient storage.

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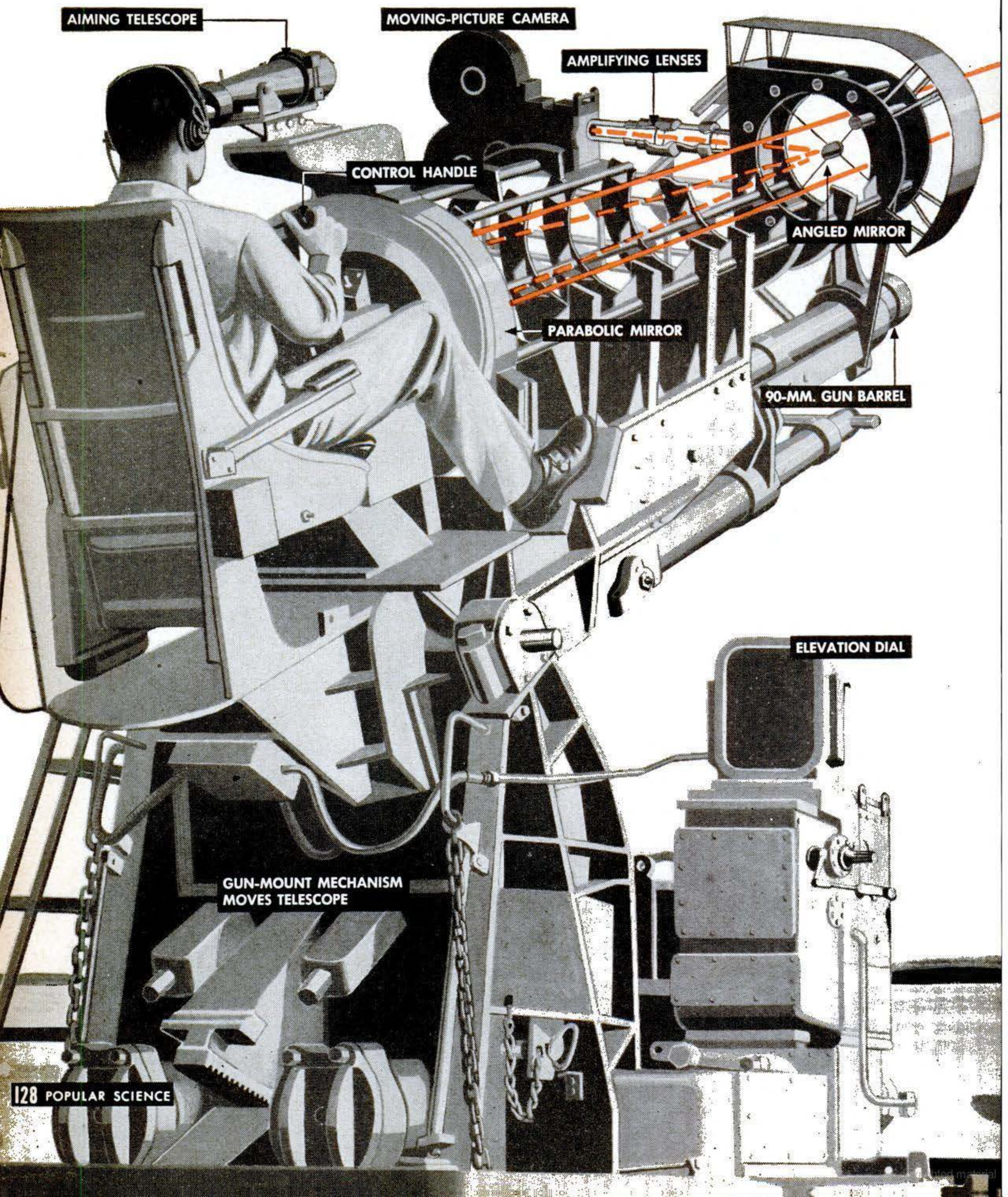
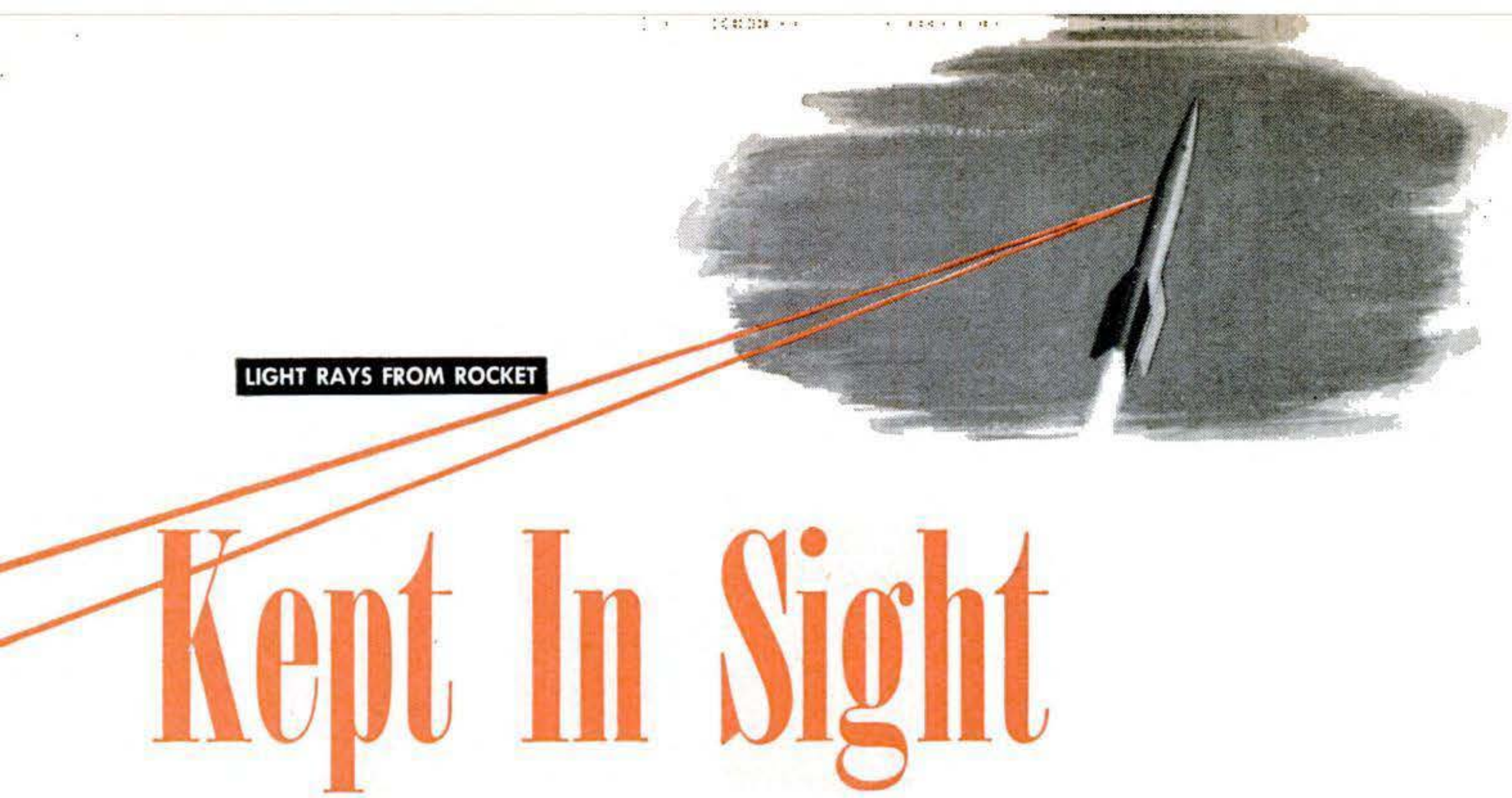
Rocket's Flight





Kept In Sight

Gun-mounted camera eye keeps movie record of V-2 missile as it speeds into space at 3,500 miles an hour.

By Martin Mann

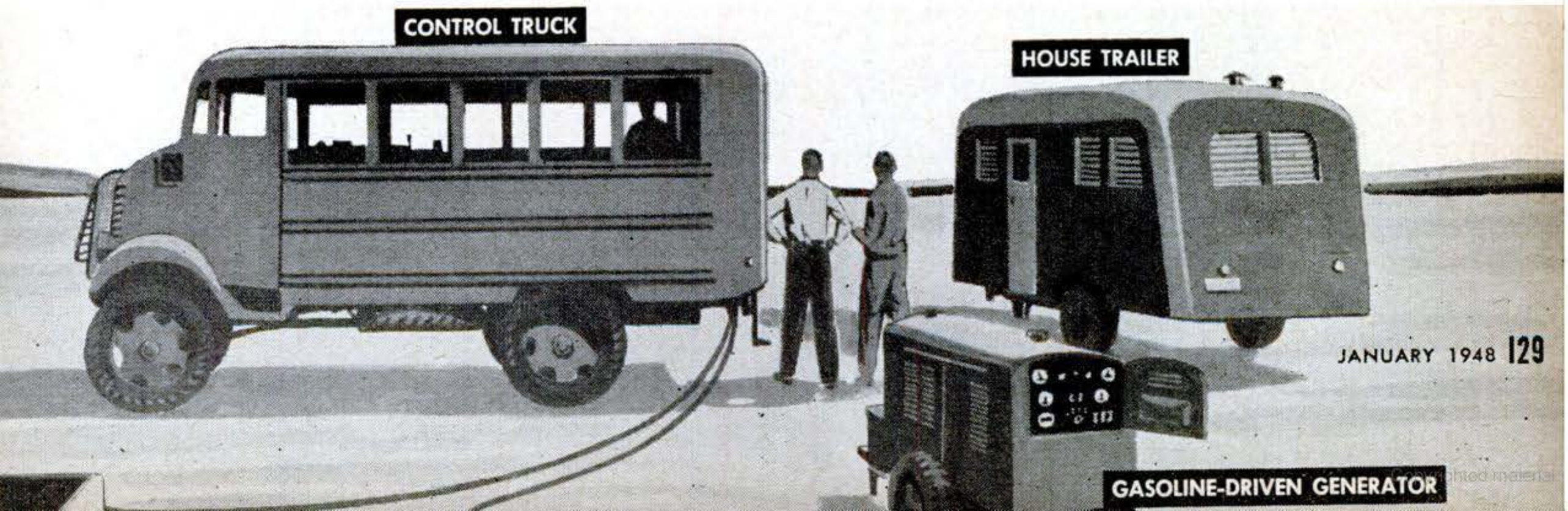
POPEYE is a seeing machine. Popeye can see things you can't see. His big glass eye can follow a V-2 zooming 3,500 m.p.h. and tell you just what it does at the 100-mile peak of its flight. But even Popeye is no match for enemy guided missiles—he could not spot an attacking rocket soon enough to sound the alarm.

Popeye—as this Rube Goldbergish invention is unofficially known—is a 16-inch-wide parabolic mirror, amplifying lenses, and a movie camera, all mounted on top of a sawed-off 90-mm. antiaircraft gun so that it can follow the fast-moving rockets. Despite its fantastic appearance, Popeye has a serious purpose: to find out what happens to high-altitude rockets after they are fired. It will be used on all kinds of rockets—the new ones made in USA as well as the V-2.

This new telescope, officially known as "Type IV Tracking Telescope," joins an imposing battery of optical and electronic "watchers" at the Army Ordnance Department's proving ground at White Sands, N. M., that already includes smaller telescopes, ballistic cameras, phototheodolites, radar, telemeters, and Doppler equipment.

Like Popeye, they are all trying to find out, for every vital second of a rocket's meteoric flight, where the missile is, when it's there, and what it's doing there. These devices are not designed to spot attacking missiles, although one researcher suggests that a big telescope might be fitted with a heat detector (a bolometer or thermocouple) instead of a camera and be used to locate incoming missiles by the heat from their rocket jets.

Astronomers already use such a system to track stars automatically. It would work fine as long as the missile approached along a straight line of sight from high altitudes. But no telescope can see through the earth. An attacking missile might come in to the target at a low level, hidden by the horizon until the last 50 miles or so. At 3,500 m.p.h. a rocket covers those 50 miles in less than *one minute!*



Popeye operator sits behind big mirror and sights through a small auxiliary telescope. Responding to his signals, hydraulic system moves sawed-off 90-mm. gun up, down, or sideways.

But the array of observing instruments at White Sands will provide the basic facts needed to make better rockets. They will also benefit other branches of science, for the data gathered should reveal much about the temperature, density, and similar characteristics of air in the mysterious region 100 miles or more above the earth. All these things must be known before men can fly there.

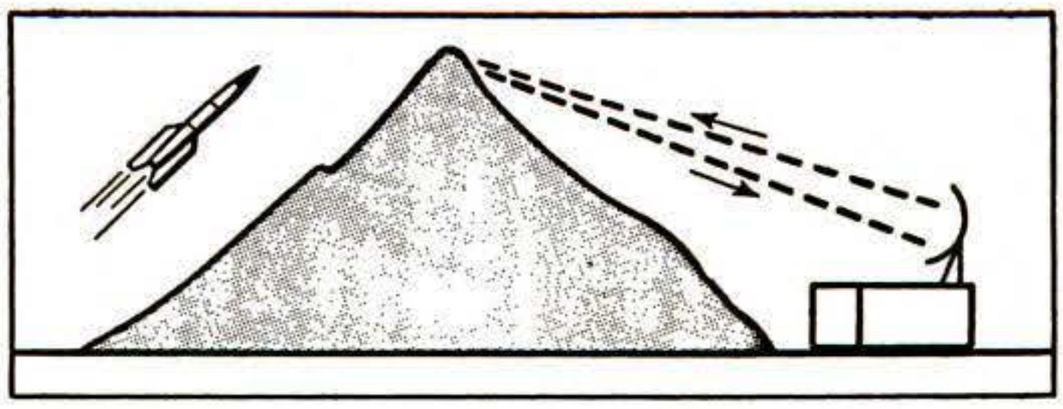
One reason we don't have space ships yet is that we don't know how a speeding rocket twists and turns and tilts. If the scientists knew, they might be able to design better controls that would keep the rocket straight. Popeye will tell. Its camera snaps a picture of the rocket 16 times every second. After the flight, experts project each picture on a screen, and measure how much the rocket moves around between consecutive photographs.

The camera also records dials that show time and the angles of elevation and azimuth. The time dial is governed by the ultraprecise "ticks" of a vibrating crystal in a clock located in the control trailer. As a further check on time, radio signals sent every second from the launching site operate a neon glow lamp in the field of view of the camera, making a dark "pip" on the edge of the negative. From all this information on the film, technicians can calculate the speed and path, or trajectory, of the rocket. Explosions and the operation of parachutes and other special equipment also show up on the film.

The telescope itself is similar to those used by astronomers. A 16-inch parabolic mirror gathers light and focuses it on an angled mirror that reflects it to one side toward the camera. Before reaching the film, the image is further enlarged by a set of amplifying lenses that can be adjusted to give an effective focal length as great as 80 feet. The recording cameras are standard Mitchells or Akeleys, like those used in Hollywood studio and newsreel work, modified for their rocket-photographing job.

Popeye watches the rocket flights from an 8,000-foot mountaintop 40 miles away from the launching area. If the telescope were much closer, the technician who aims it would not be able to move fast enough to follow speeding V-2s as they take off. The high-altitude location also has another advantage, since it eliminates much of the shimmering caused by the normal movement of the air near the ground. This shimmering—the same thing that causes mirages in a desert—is the reason stars twinkle when seen with the naked eye. As there is less of this effect in the rarefied air atop high mountains, such locations are favored for big telescopes.

Even more accurate than Popeye at tracking the path of a rocket is "dovap," a radio tracking system also developed by Army Ordnance's research laboratories at Aberdeen Proving Ground, Md. It uses the Doppler effect, the change in the frequency of a radio wave caused by movement of the transmitter or receiver. The faster the transmitter moves, the more the frequency changes.



Adequate warning of guided missile attack must await invention of a detector that can look through mountains, or over the horizon.

This same thing happens to all kinds of waves—light and sound as well as radio. The wailing sound of a passing train's

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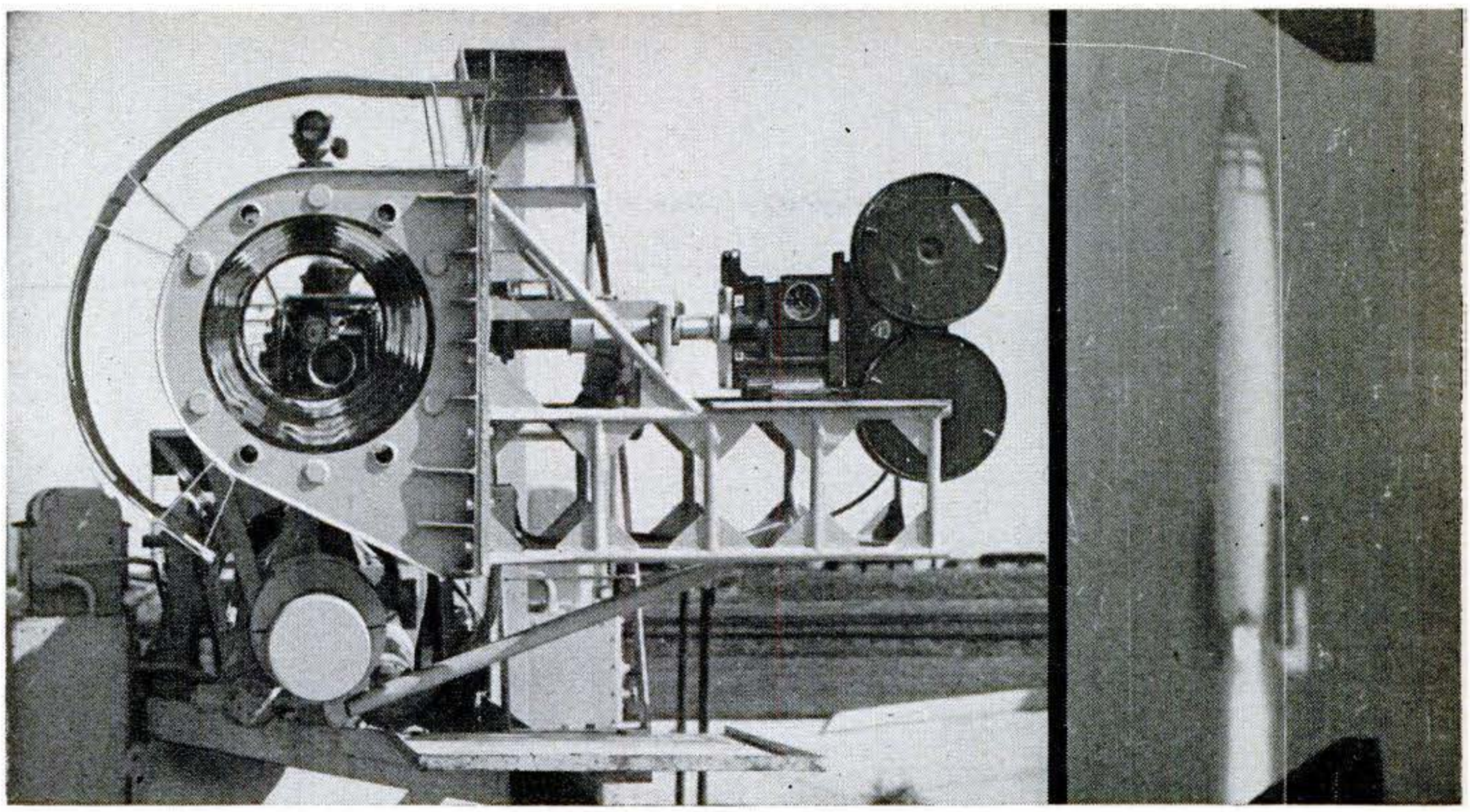
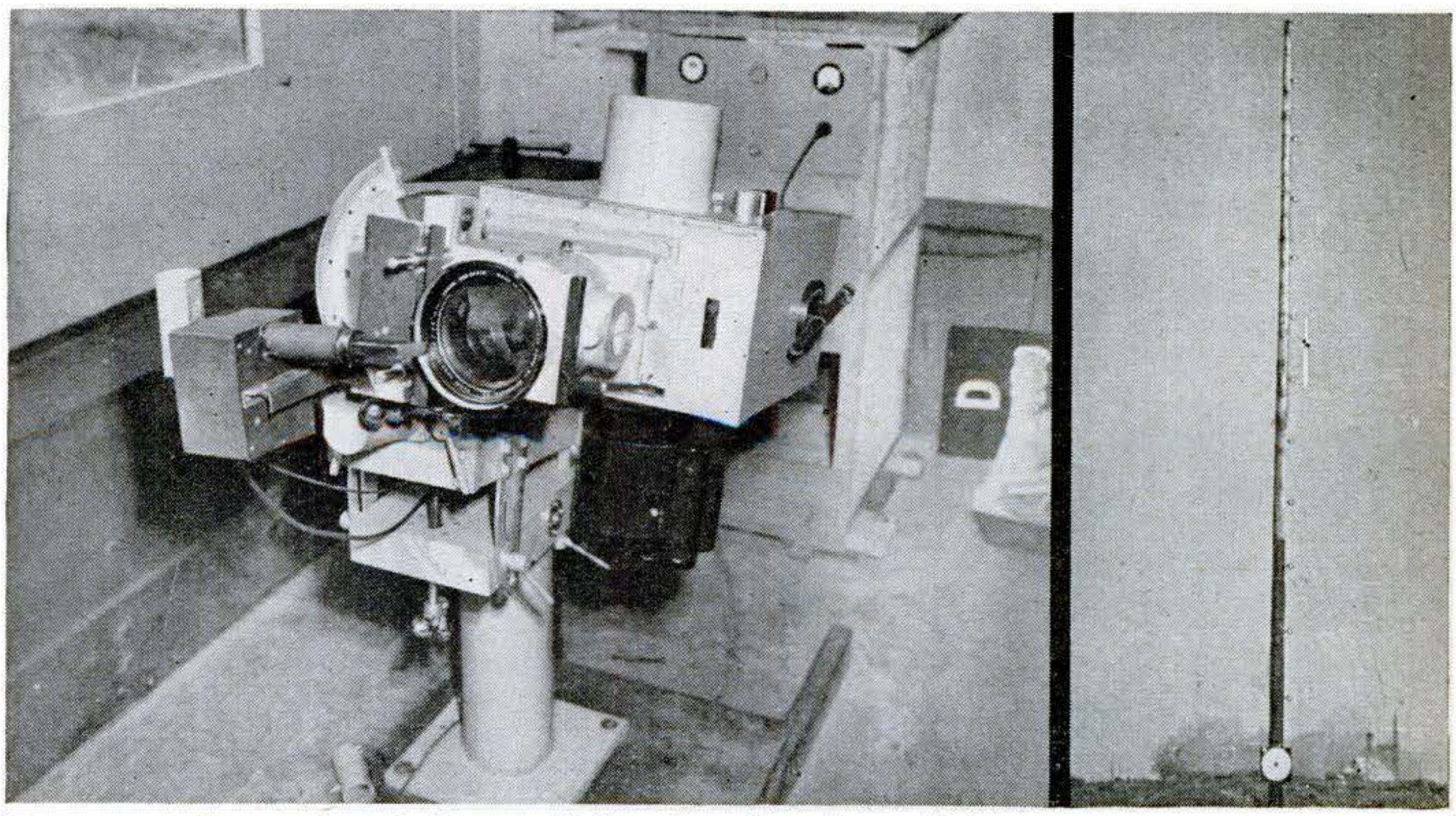


Looking straight down Popeye's barrel, you can see the parabolic mirror, and if you examine the picture closely (left, above) you can even pick out the reflection of PSM photographer Morris's camera. To Popeye, a V-2 will look like the photo at the right, which was made with a smaller telescope. Black marks are reference points to aid measurements on the film.

whistle, for instance, is caused by the Doppler effect. The frequency (pitch) of the sound from the whistle goes up as the train approaches and down after it has passed. In this case the whistle is the moving transmitter and your ear the stationary receiver. Records of frequency changes give a measure of the speed of the transmitter.

The dovap equipment used at White Sands sends a steady radio signal to a combination transmitter-receiver located just behind the war head of the V-2. This transceiver picks up the signal, amplifies it, and sends it back to a ground receiver. The ground receiver compares the signal from the rocket with the original signal sent out



Fastest moving rocket is "stopped" by the 1/10,000 second exposure of the Bowen-Knapp camera shown at left, above. At far right is one frame taken by this camera during rocket launching. Pole in center serves as a point of reference; white object halfway up is the missile. Measurement of films gives rocket's position, velocity, acceleration, and attitude.

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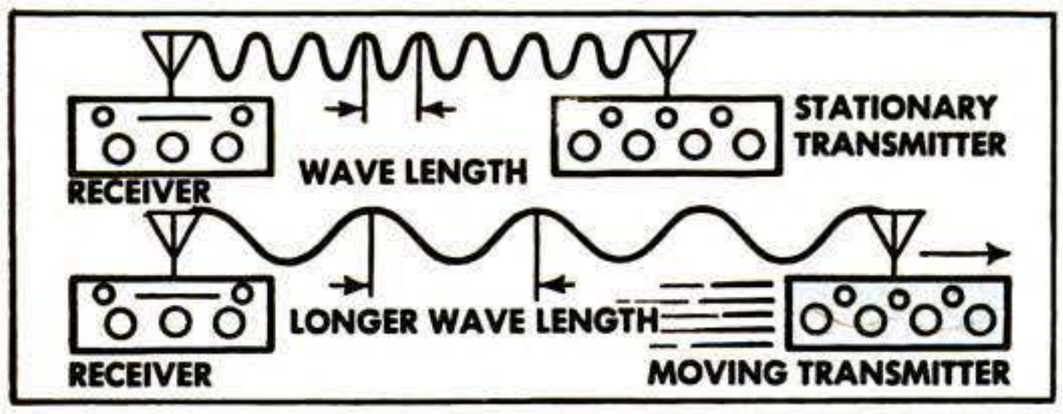
from the ground transmitter. The difference between the two signals, called the Doppler frequency, is recorded on automatic instruments.

Each cycle per second of Doppler frequency received means the V-2 has moved in that second half a wave length farther away from the ground station, or about 6.25 feet in the case of dovap's 77,000 kilocycle signal (it becomes a bit more complicated when the ground receiver is separated some distance from the ground transmitter, as it is at White Sands). Thus, if the Doppler frequency is 800 cycles per second, the V-2 must be moving 6.25 x 800, or 5,000 feet per second.



How a moving transmitter "stretches out" a radio wave to increase its wave length—the Doppler effect—is illustrated here.

A complete record of the Doppler frequency spots the position of the rocket within a few feet and measures its velocity within three-tenths of a foot per second. This information is fed into Aberdeen's "Eniac" computer (PSM, Apr. '46, p. 83), which turns out in seven minutes 2,500 numbers indicating more than 800 positions along the path followed by the V-2 (ordinary computing methods would require several weeks of work for the same job).

Other instruments in the battery of observing devices at White Sands measure the same things in different ways. Many types of radar sets follow the flashing rockets. Some have telescopes attached for final, precision adjustment of the aim of the beam. Others are held on their target by a small beacon transmitter in the rocket itself, so that the radar receivers get a strong signal.

Phototheodolites, which are essentially movie cameras with big telephoto lenses and accurate direction indicators, furnish the same sort of record as the big telescope, but can follow the rockets only about 50 miles.

Other instruments already in use at White Sands include special cameras and several telescopes smaller than Popeye. And Ordnance researchers are already planning another new telescope, still bigger than Popeye, to follow new rockets that will far outdistance the V-2. END

Ballistic camera above is similar to instrument used by astronomers to photograph stars. Two synchronized cameras, set up at end points of a base line, are operated simultaneously.

Night firing of a V-2 registered on a single plate. Broken line is trail of the missile's jet; curved lines are star trails. Space between dashes gives accurate measure of speed.

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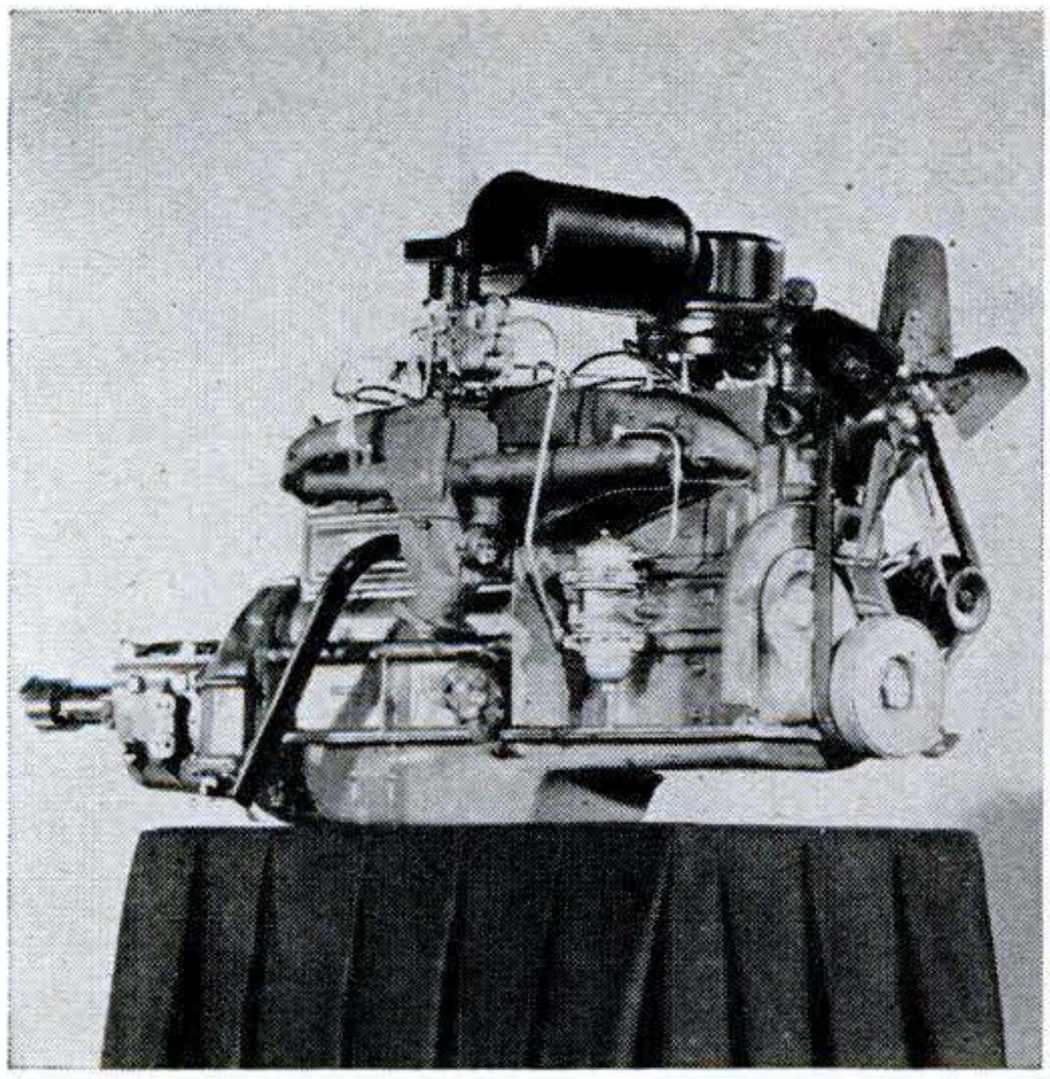
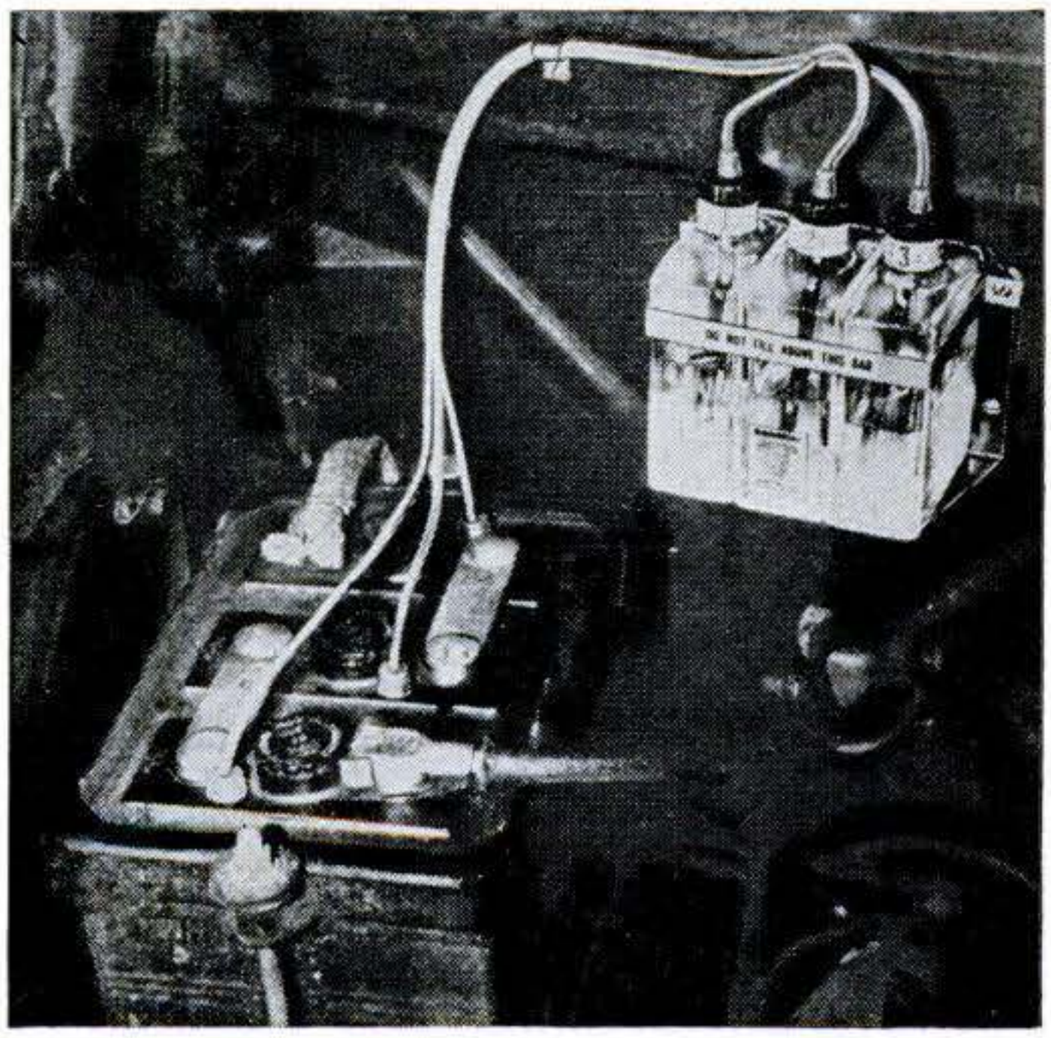


More Power for You

By stepping up the compression ratio to 7 to 1 from the former 6.85 to 1, Packard has increased the power of its 1948 straight-eight series of engines. Largest is the 160-hp., 356-cubic-inch engine shown above. A new hardened crankshaft sprocket plus a new roller-pin type of timing chain are said to give the engine longer running life.

Painless Tire Pumping

Tired of pumping tires? With an Auto-Vac, the mere push of a button puts the motor of your car to work inflating that slow-leaking tire. Operating off the windshield-wiper vacuum line, the device will raise a tire from flat to 30 pounds' pressure in less than six minutes. The Power Brake Mfg. Co., of Detroit, makes this labor-saver.



No More Dry Batteries

You need refill your auto battery only twice a year with the new Aqualator, according to the Embree Mfg. Co. Shown at upper right, the device uses engine heat to expand air in the three sealed containers so that the air pushes water to each battery cell. When a cell is full the water rises to the tube end and stops the flow.

Step Down, Please

That's an invitation to enter the new lower-center-of-gravity 1948 Hudson. It results from the floor being set even with the lower edge of the frame, instead of on top of it, so that the floor is below the door-sill. The car is only five feet high, yet is spacious, with plenty of headroom. A tunnel along the floor holds the drive shaft.

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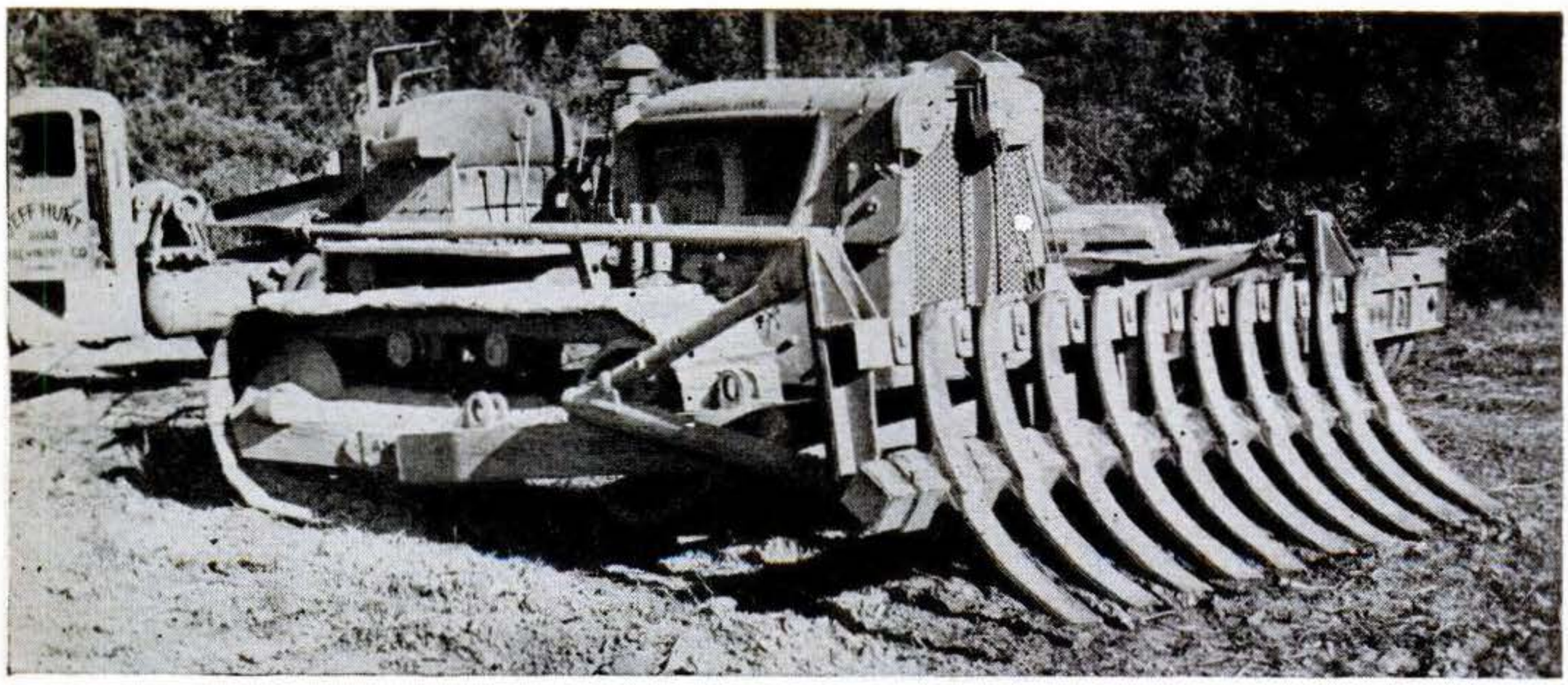
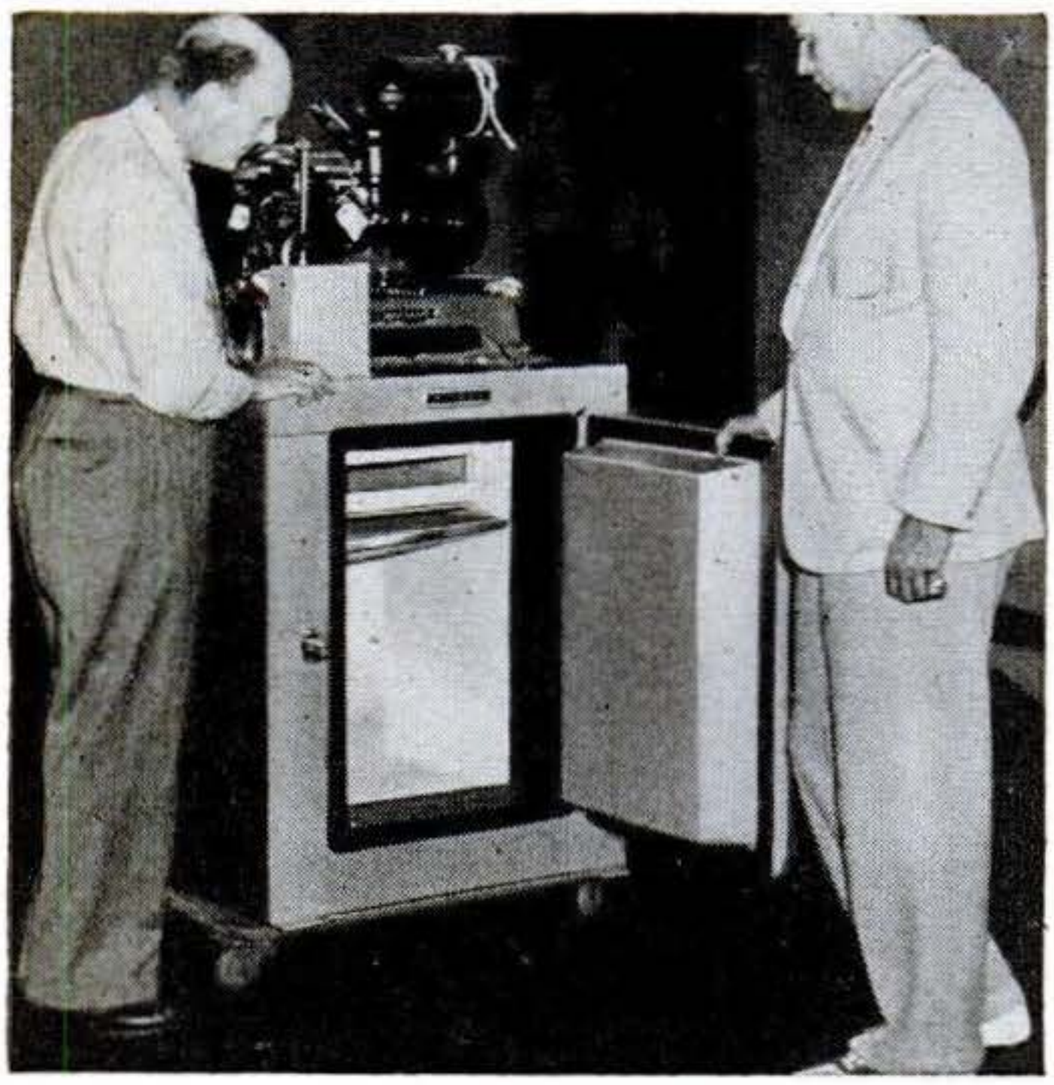


Getting at the Roots

THE massive teeth of this big fellow really dig in, biting 16 inches into the ground to haul out stubborn roots for clearing farmland or highway rights-of-way.

Designed for use with Caterpillar Diesel track-type tractors, the Fleco Root Rake is made by the Florida Land Clearing Equipment Co., of Jacksonville, Fla. Its alloy-steel-cast teeth dig out top growth and roots in a single operation and dispose of the cuttings without excessive soil piling. A companion piece, a four-bladed stumper designed for attachment to the frame of angling bulldozers, makes short work of tough trees, stumps, and boulders. The latter's teeth cut 24 inches deep and 36 inches wide.



Keeping Films Frigid

WORST enemy of a photographic explorer in Africa is not the king of beasts but the heat. The portable, gasoline-powered refrigerator shown above was designed by Wilson Refrigeration, Inc., of Smyrna, Del., for an expedition of the Philadelphia Academy of Natural Sciences. As a chill box for color films and medicines, it maintains a temperature of 50° for five hours after the power is shut off, making it unnecessary to run the condenser unit during periods of travel.

First Aid for Carpets

A THIN smear of a new liquid white-rubber compound is all that holds together the two pieces of carpet padding shown above. But if you try to pull them apart, the padding will tear before the joint gives way. This self-curing adhesive, called Rug-Sealz, not only cements carpet ends, but repairs areas of dry rot and acts as an antiskid agent when applied to the back of a rug. A product of the U. S. Rubber Co., the new compound is odorless and dries in an hour.

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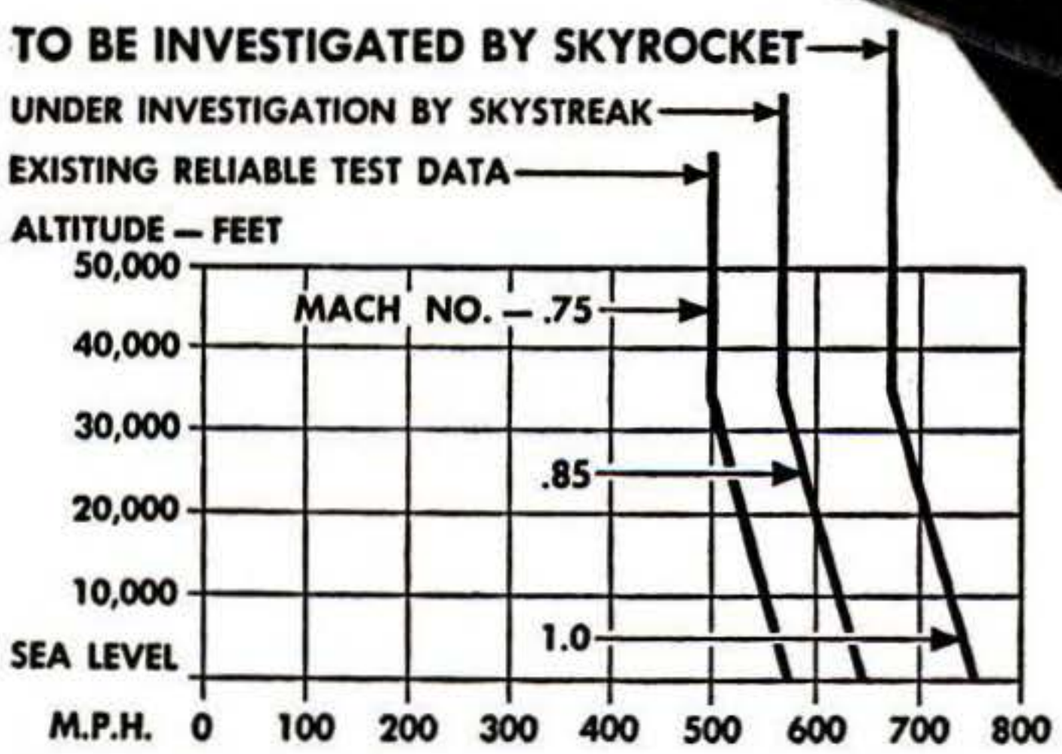
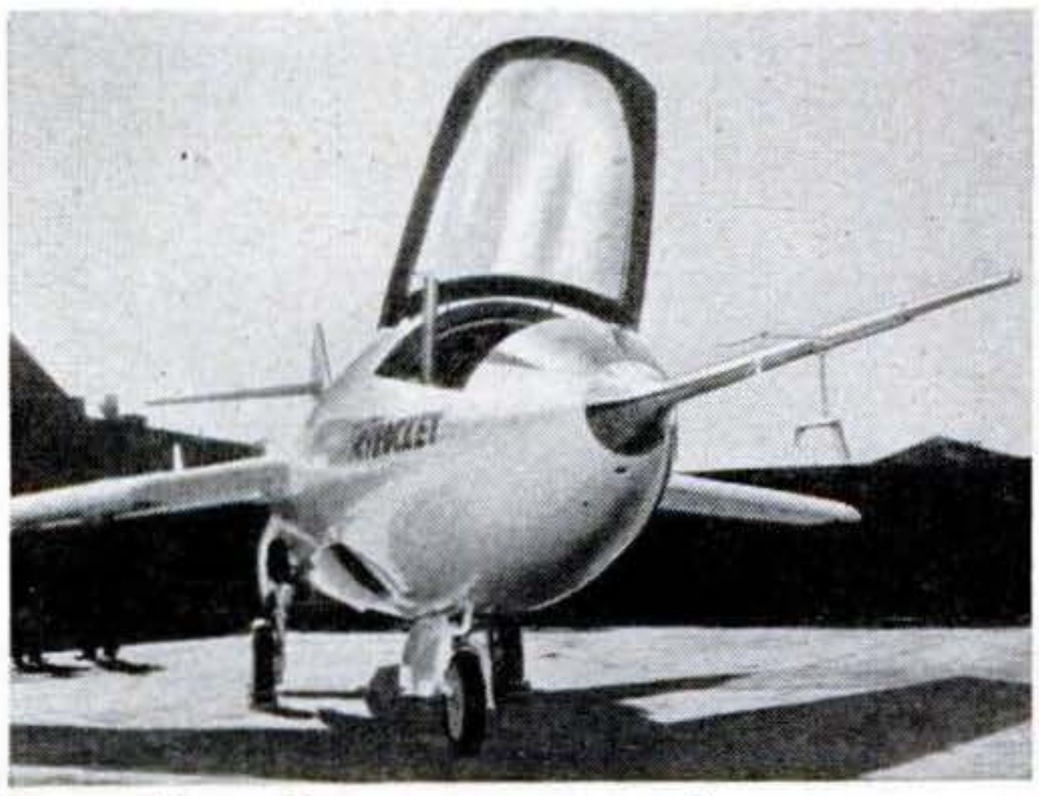
Fastest Thing On Wings?



Heavy lines indicate Mach numbers, used to gauge ultrahigh speed. They are decimal fractions of speed of sound, which drops from 760 m.p.h. at sea level to about 670 at 35,000 feet.

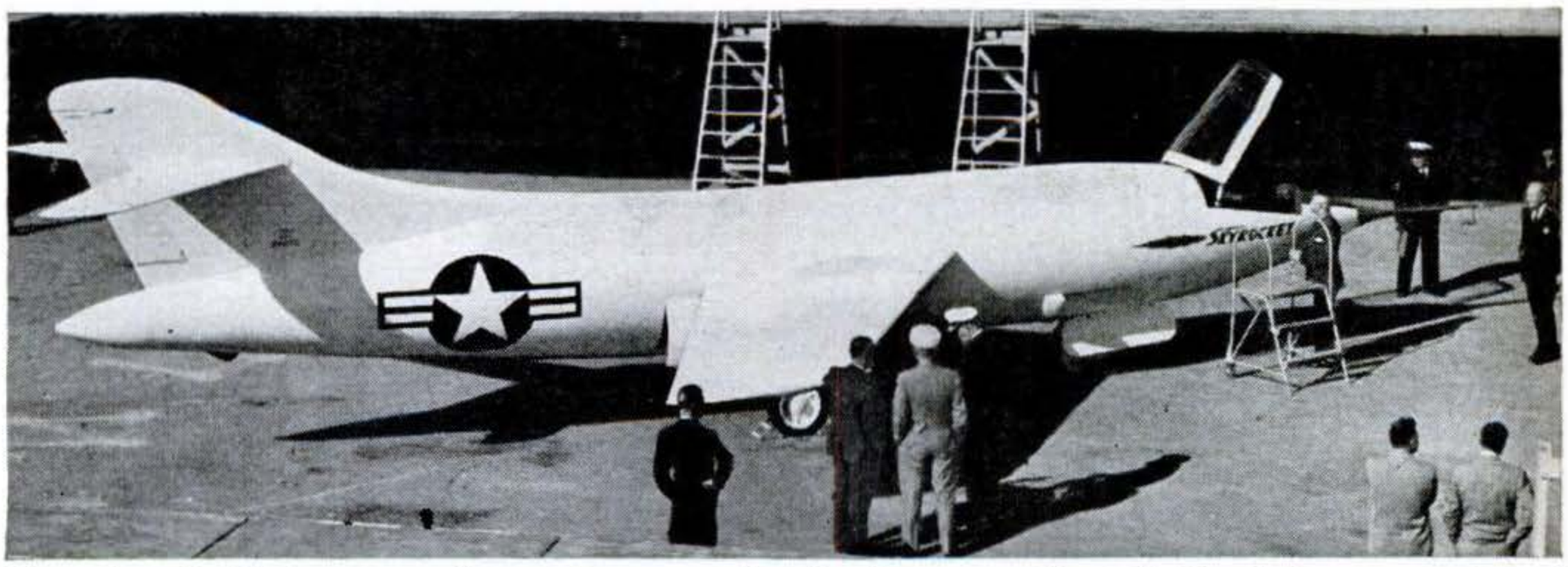


Nose "lance" contains pitot tube to gauge air speed. All three wheels fold into fuselage.

WITH jet power for take-off and flight, plus rocket power to help it poke its needlelike nose into the secrets of sonic speed, the Navy's new Douglas D-558-2 Skyrocket is designed to fly faster than any piloted aircraft has ever traveled before.

Successor to the D-558 Skystreak, which boosted the airspeed record to 650.6 m.p.h., the D-558-2 is expected to explore the 650-750-m.p.h. zone. Besides a liquid-fuel rocket for peak power, it has swept-back wings and tail to minimize shock waves at transonic speeds. (The blunt-nosed Skystreak has straight wings and only jet power.)

The pressurized cockpit, enclosed in the fuselage without even a bubble canopy, has both heating and refrigeration for the pilot's comfort. For his protection, the entire nose and cockpit section can be jettisoned for high-speed escape. Air brakes will help control the plane's pace, and automatic wing slots will improve lift at low speeds. And when the pilot turns on the rocket's blast to lunge into the transonic zone, scores of instruments will record what happens.



The plane is 45 feet long, has a wing span of only 25 feet. The jet exhaust is on underside of fuselage near the tail. Vertical vane on top of the wing restricts spread of low-speed stall.

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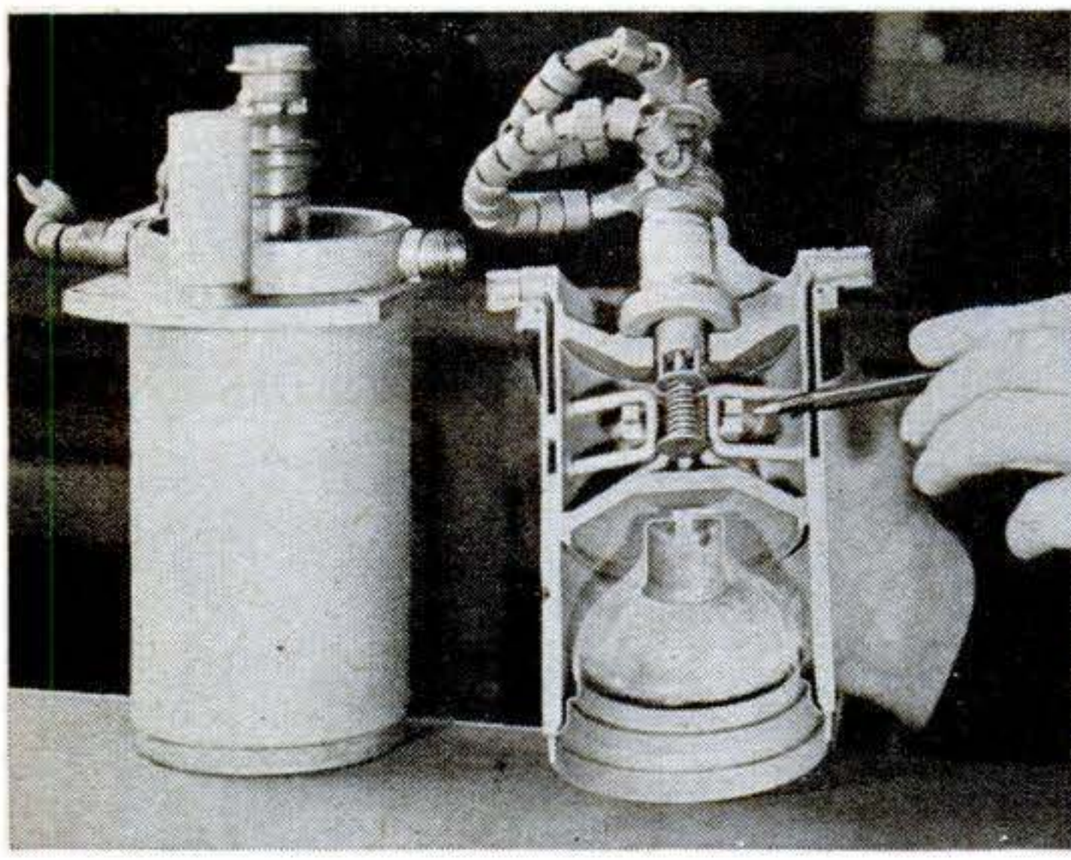
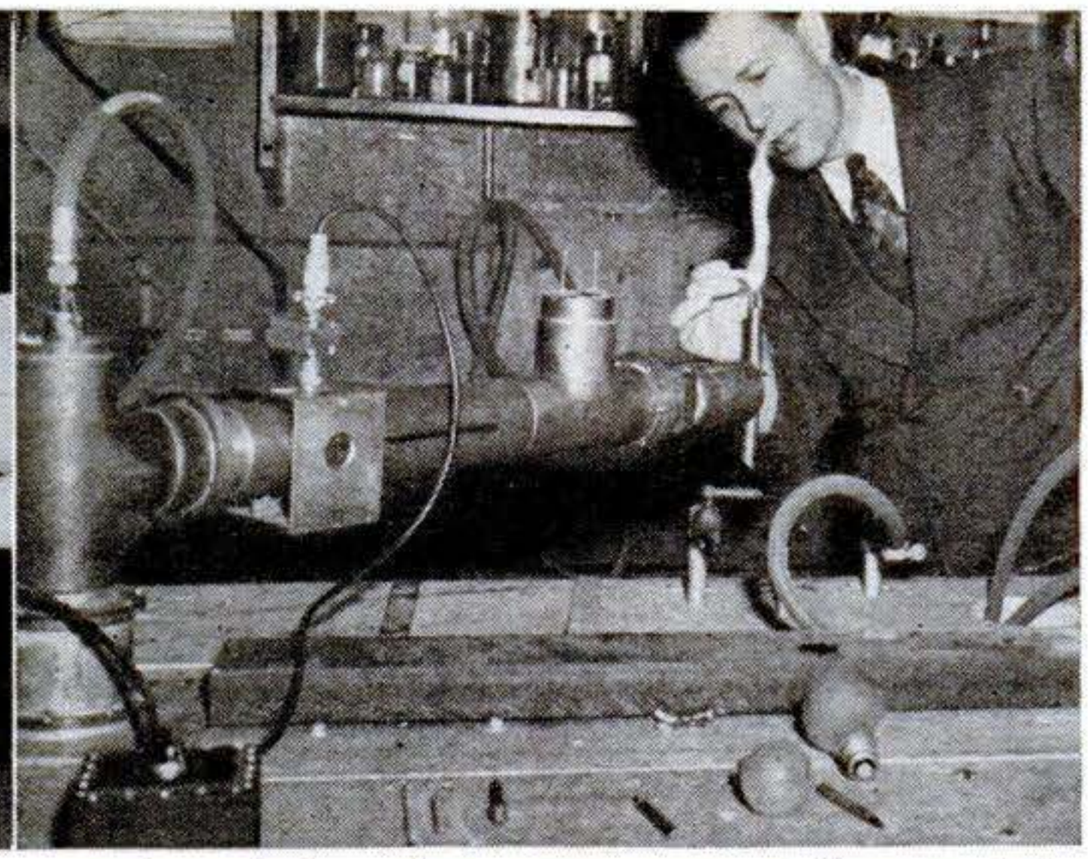




Hot Radio Waves

WHEN GE research engineers run out of matches, they can gingerly light their cigarettes with radio waves from the tip of the armlike antenna at right, above. These "hot" high-power radio waves, 11 inches long, are produced by the magnetron tube at left, above. Developing 5,000 watts, the tube is based on designs for jamming German radar and delivers its energy continuously, not in the short bursts of ordinary radar tubes. The waves can be used for heating plastics and thawing frozen foods.

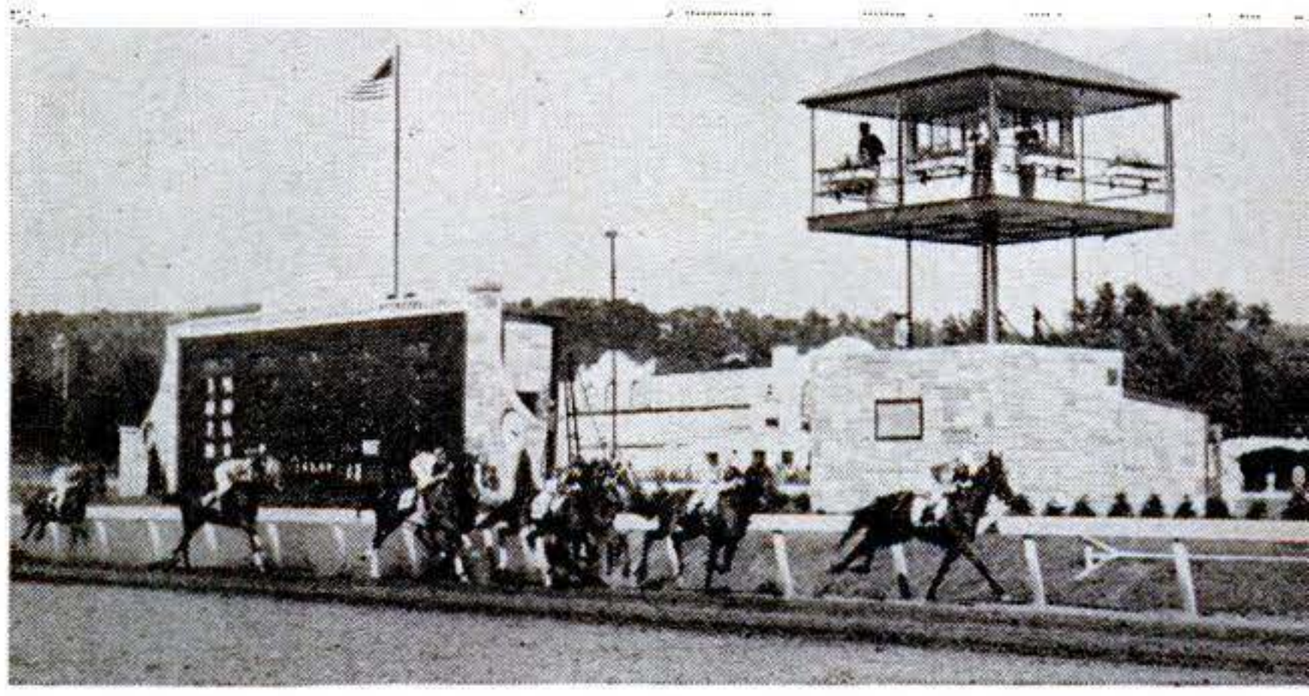
New Glass Defies Acid

THE stuff shown in the bottom of the glass tube at left is hydrofluoric acid, which eats glass in no time at all. Yet it has been there for three weeks! The answer is a new type of sandless glass that will give chemists their first chance to watch what goes on in experiments with the violent acid which, besides being used to etch glass, is employed in oil refining and synthetic rubber making. Formerly the acid had to be handled in platinum or gold retorts.

Since hydrofluoric acid has a disintegrating effect on sand, the major ingredient of ordinary glass, the new fluorineproof glass is made mostly of phosphorus pentoxide. The new product was developed by the American Optical Co., during atomic bomb research for handling another glass-eating chemical, uranium hexafluoride.

Following the Ponies

JUDGES at this race track are on the up-and-up. Hydraulic cylinder under center of the stand at right raises it eight feet above the stone foundation to give the judges a better view of the race; guide rods on either side keep platform steady. Occupants of the stand control their own rise and fall by push buttons. Used at Wheeling Downs, West Virginia, the new stand was designed by the Globe Hoist Co., of Philadelphia.



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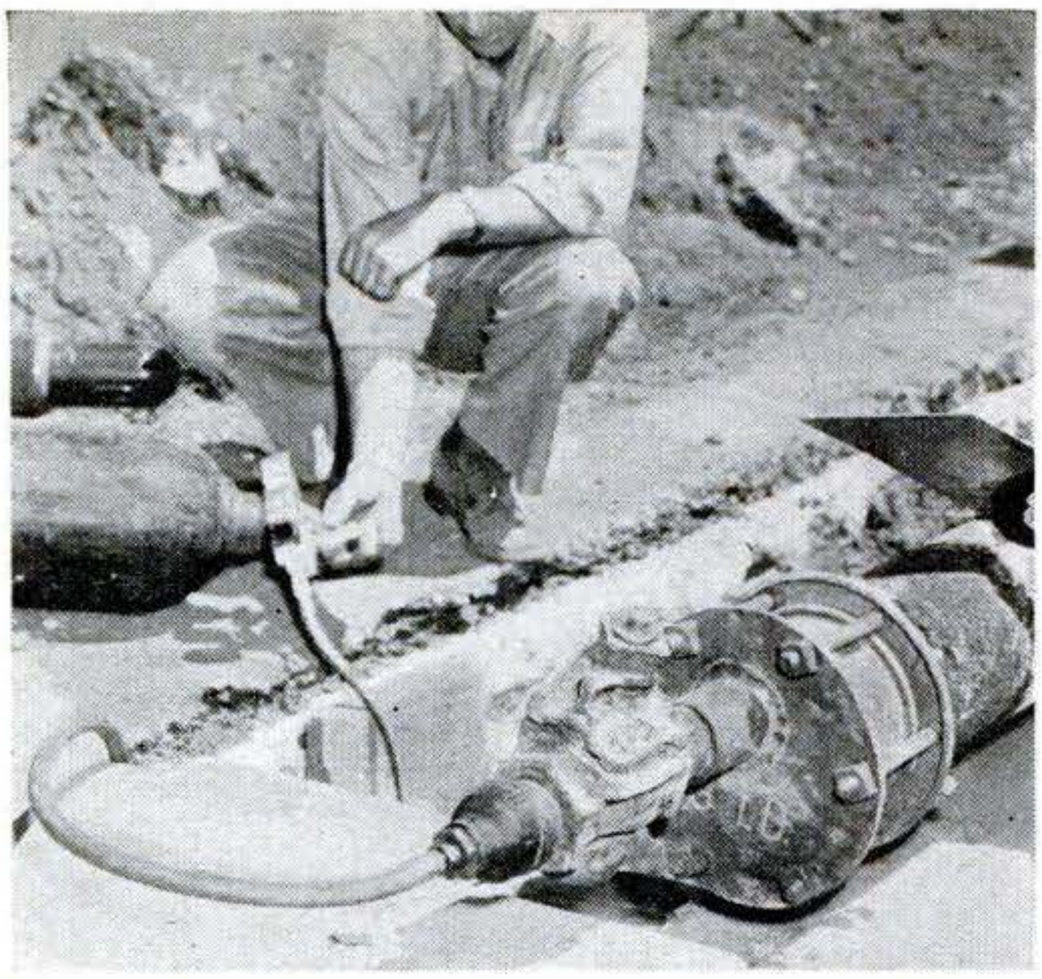
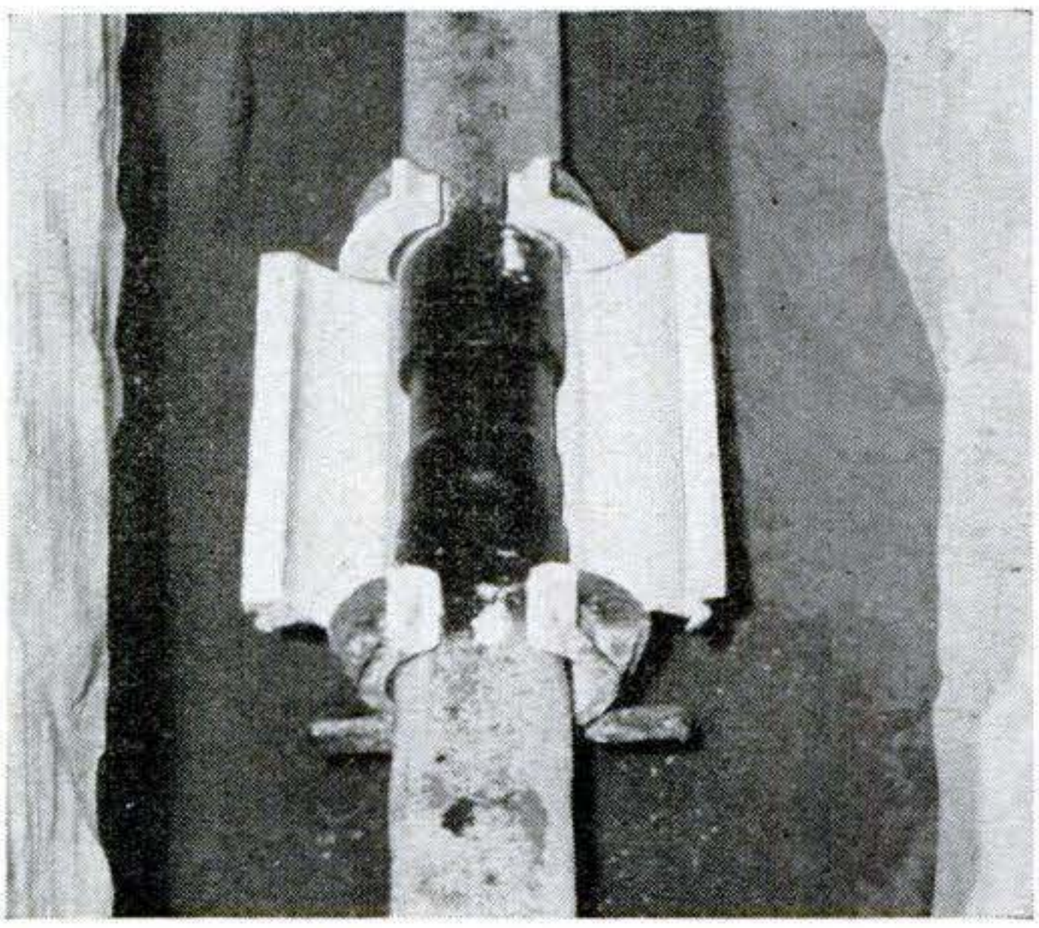


Internal rusting of the pipe is prevented by passing chemically dried air through it to remove all traces of moisture. Here it gets light charge of nitrogen to keep it dry during installation.



A special mold, open above, fits around pipe joints, where somastic is poured on after pipe sections have been laid and sealed. Except for ends, however, sections are coated at factory.

Somastic coating is examined for minute breaks by a Holiday tester, a loop of fine wires carrying an electrical charge that grounds against pipe wall if crack in covering is encountered.

Wrapping 110,000 Volts in Gas

RESIDENTS of downtown San Francisco will soon receive high-voltage electric power packed in gas. The 110,000-volt current will reach the city through four underground pipe lines, each containing three one-inch power cables surrounded by nitrogen at a steady pressure of 200 lb. p.s.i.

The nitrogen, being a nonconductor, prevents the current from arcing between the cables, while its pressure seals the insulation around them. Should the pressure drop, automatic alarms will warn operators to let in more gas or shut off the power.

Surrounding the cables is a six-inch, seamless steel pipe, with ¼-inch walls. To check corrosion, the outside is coated with a ½-inch layer of "somastic" covering, a mixture of asphalt, asbestos, sand, and mineral filler. After the pipe is sealed and filled with nitrogen, it is carefully tested for leakage of both gas and electricity.

Constructed by the Pacific Gas and Electric Co., the gas-wrapped power lines avoid both the unsightliness of exposed, overhead conduits and the tremendous insulation required for ordinary underground cables.

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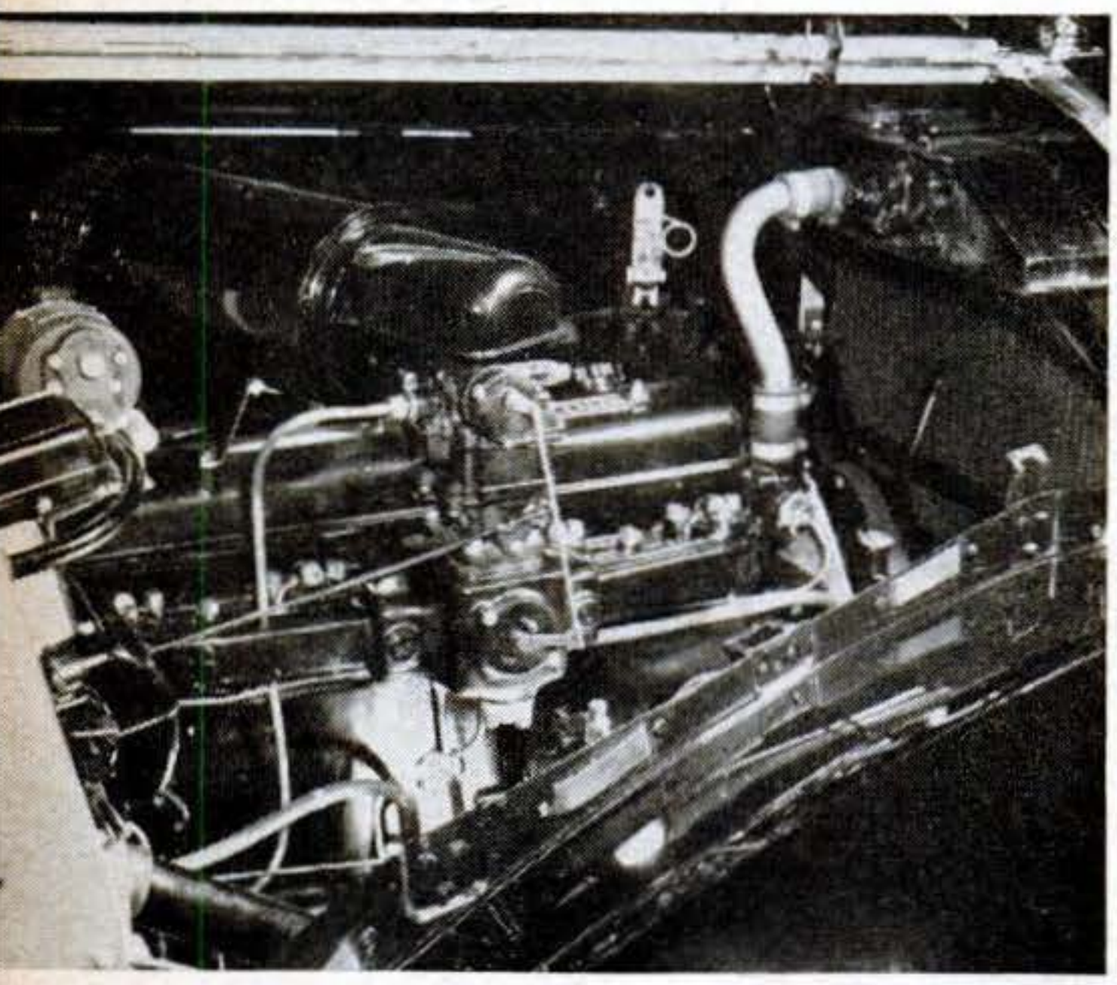
Rolls-Royce styles seldom change. As a result, the car still looks new after many years. The radiator on the 1947 town car above is the same shape as that of the original 1904 Rolls-Royce.

Luxury for Sale: Price, Only $19,200



Engineering perfection, a Rolls-Royce goal, is shown in the six-cylinder engine. Chrome-plated cylinders need not have carbon removed; new valve setup has overhead inlet and side exhaust.

THE dignified products of Britain's Rolls-Royce, Ltd., cost from two to three times as much as the most expensive American car. What does a buyer get when he planks down $18,450 to $19,200 for a Rolls-Royce, or $12,900 to $17,700 for its faster, slightly smaller sister, the Bentley?

He receives one of the most carefully engineered automobiles in the world, with such refinements as separate high- and low-pressure oil systems, a vibration-reducing spring drive between engine and cam shaft, servo-controlled brakes, and a one-push pedal that grease-guns the car. Five months' handwork will have finished the body to his personal taste—in England the customer is invited to the factory to check on progress. **But although the buyer pays heavily for tradition and mechanical beauty, he gets quality and performance that are timeless.**

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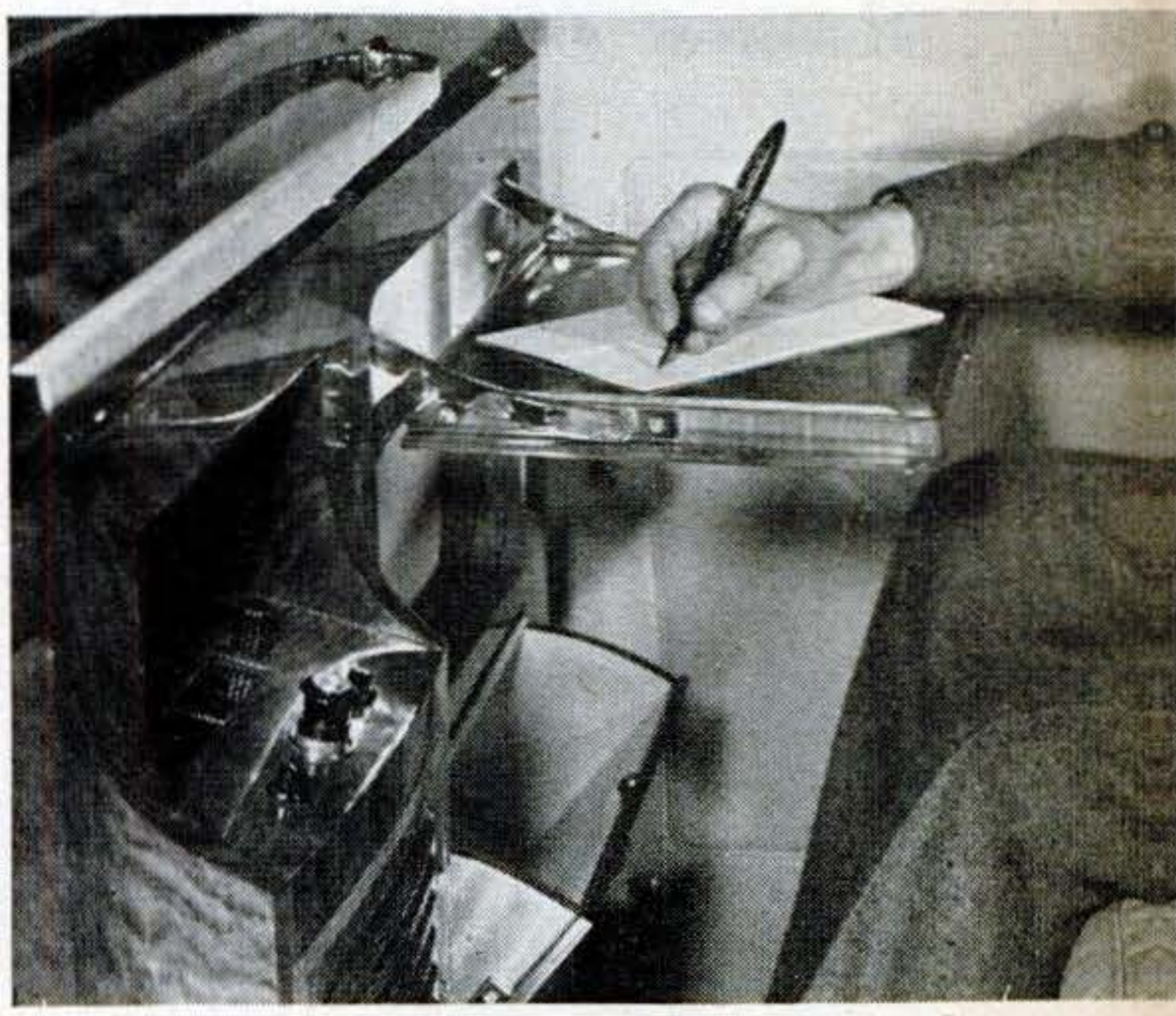
BRITISH CARS FEATURE THESE CONVENIENCES

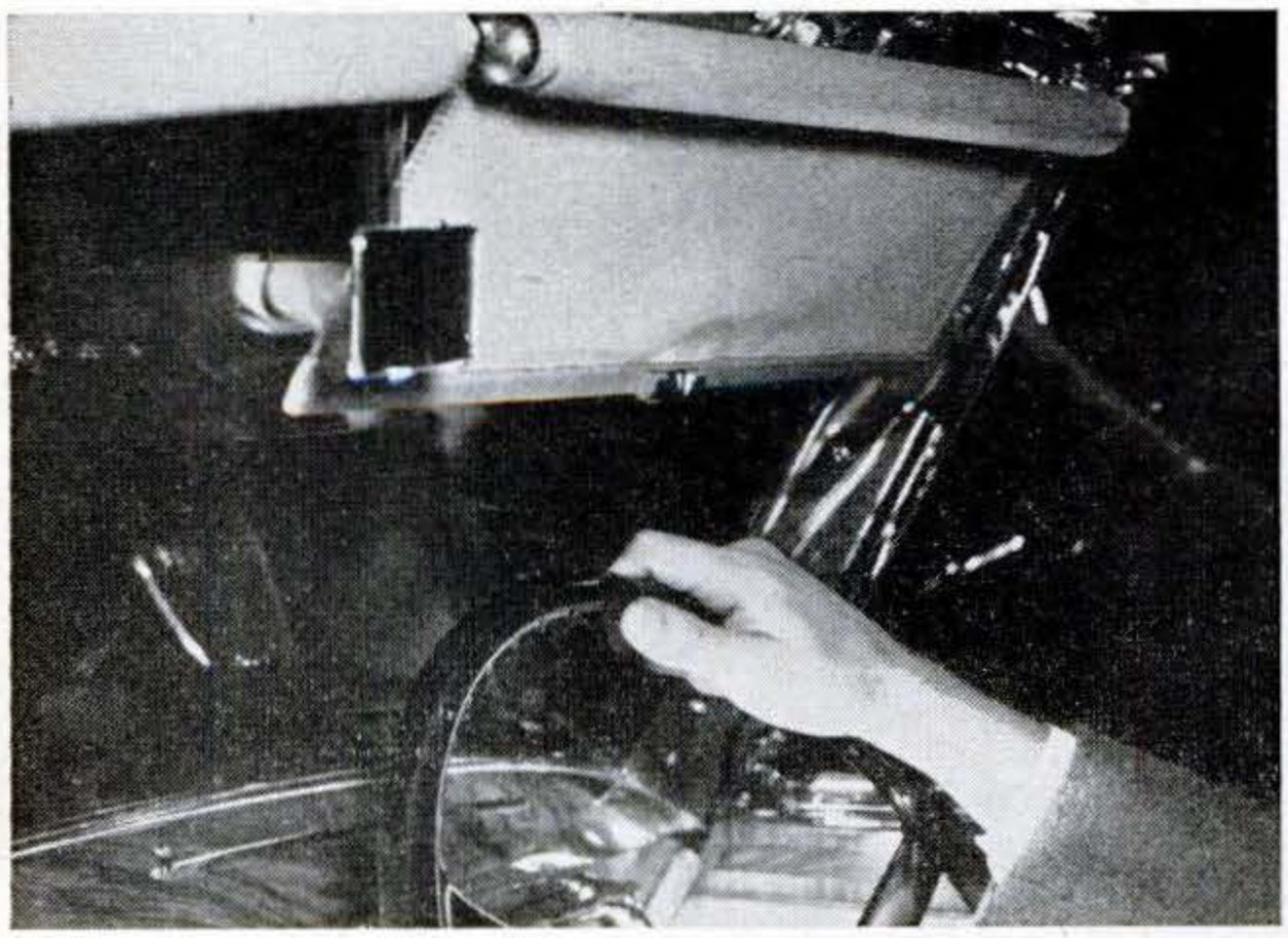
Bentley tools are neatly stored in a dashboard drawer. An amber light on the instrument panel of both the Bentley and Rolls starts blinking if the gasoline supply drops to two gallons.

A set of tools is carried in the Rolls trunk. Directly ahead, in the trunk itself, are two removable suitcases. The spare tire is stored flat behind a panel just below the trunk door.

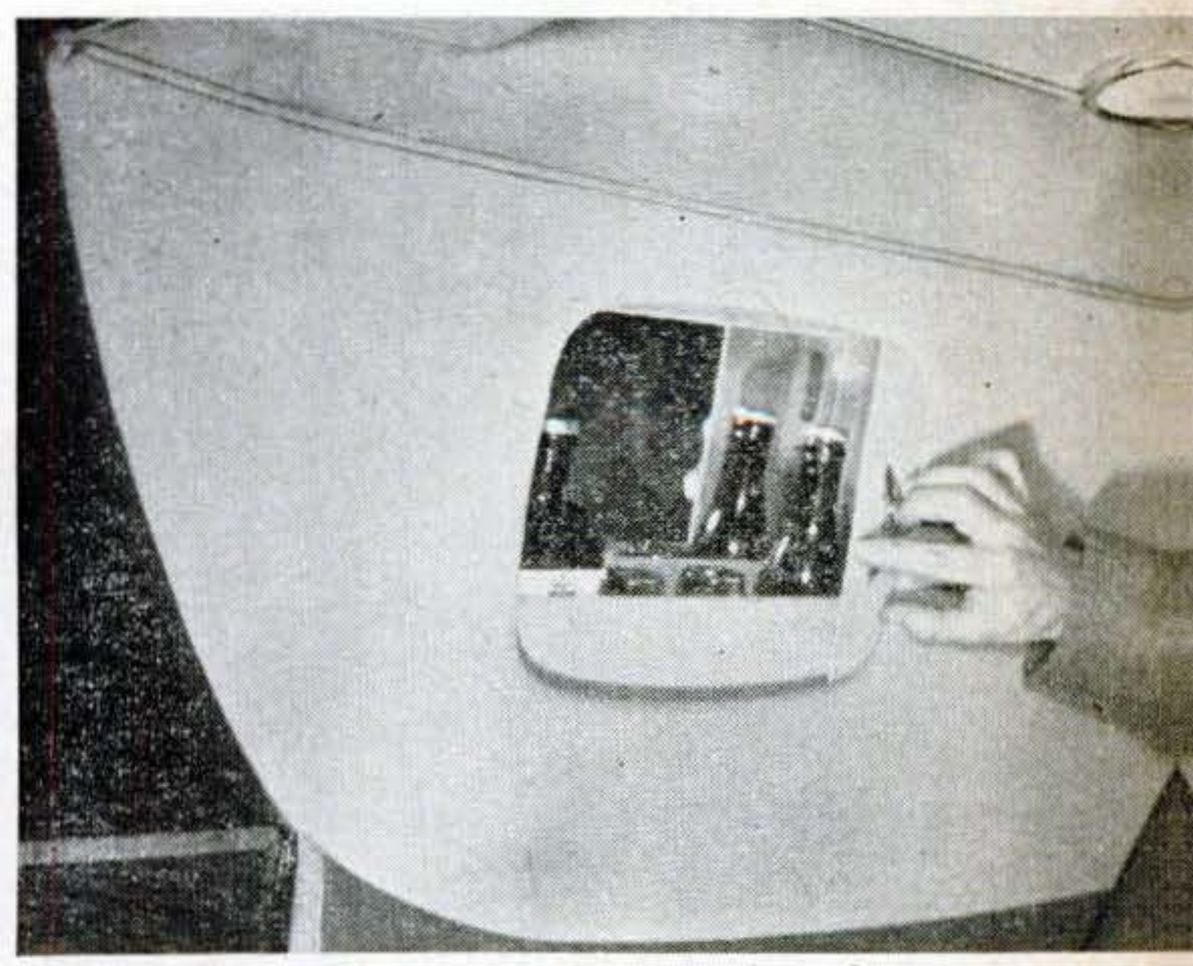
Shock absorbers may be adjusted for "hard" or "soft" riding at different speeds by moving a small knob on the steering wheel. Top speed of the Rolls is 90 m.p.h., a Bentley does 100.



Home conveniences are found in the Rolls town car. A desk, radio, and parcel compartment are all located on the back of the front seat. An individual electric motor operates each window.



Reducing mirrors are a feature common to both the Rolls and Bentley. Although small, these give a view of a large rear area. Instead of visors, a Bentley has pull-down roller shades.



Liquor compartments also are found in some models of both the Rolls and Bentley. This one, in a Bentley, also serves as a vanity, a mirror being located behind the storage shelf.

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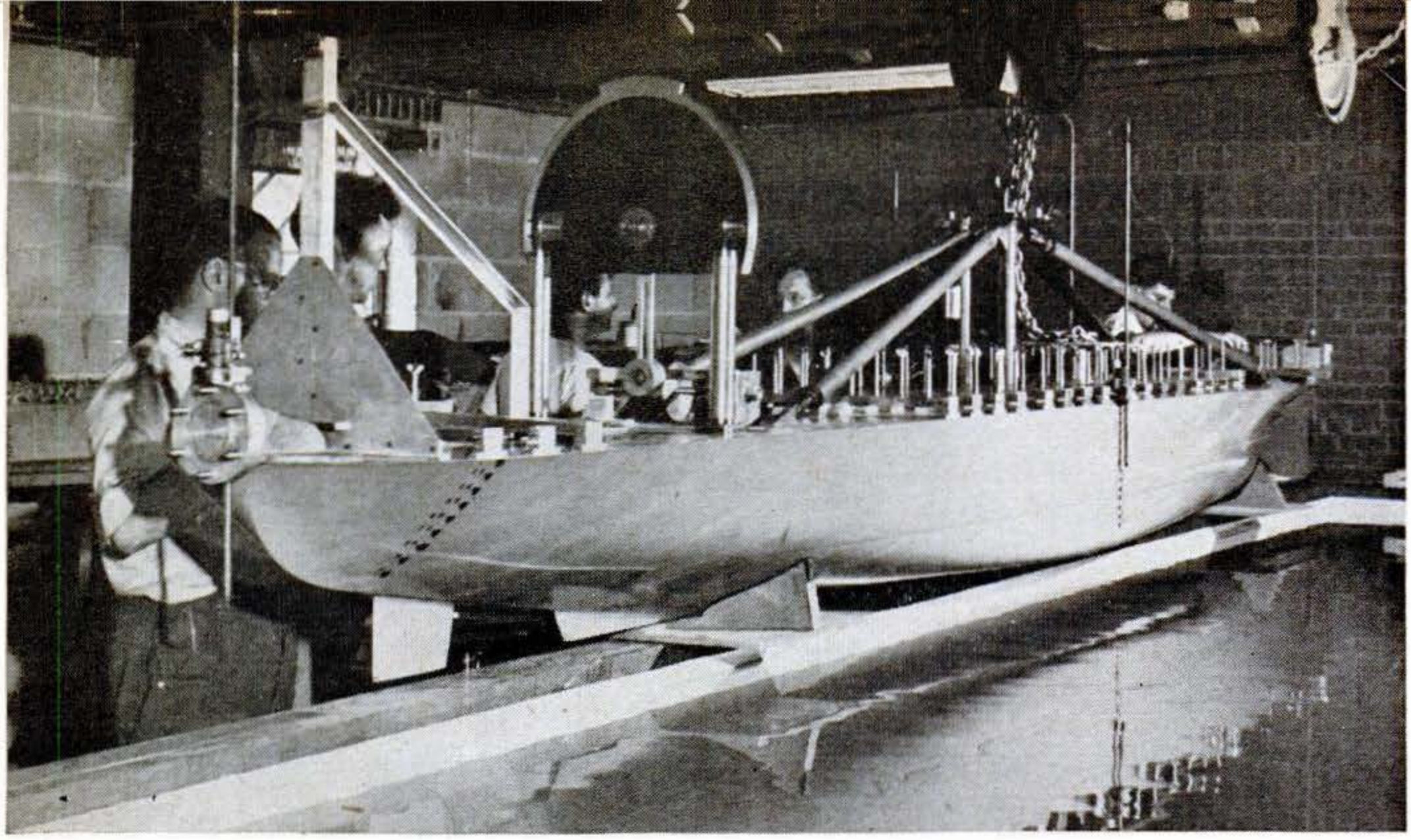

Model Carrier Launched

ABOUT to slide down the ways, this 20-foot wooden scale model of a Navy carrier will make her trial runs in a 40-foot-long test tank at the Stevens Institute of Technology. A sensitive inclining device will give an accurate report on the ship's stability. Another, larger model, made of aluminum, is built with compartments that can be flooded to simulate conditions that might occur when a carrier is damaged at sea.

Hairline Air Line

THIS l'aris, France, youngster pilots a realistic model airplane through the perils of his first haircut. Less air-minded small fry can be snipped while riding a merry-go-round or mounting a roarless lion.

A Five-Story Tin Can

PHANTOM view above shows how five different vegetables share the new Layer Pak tin can put out by the Larsen Co., of Green Bay, Wis. The various layers of vegetables are separated by parchment-paper walls.

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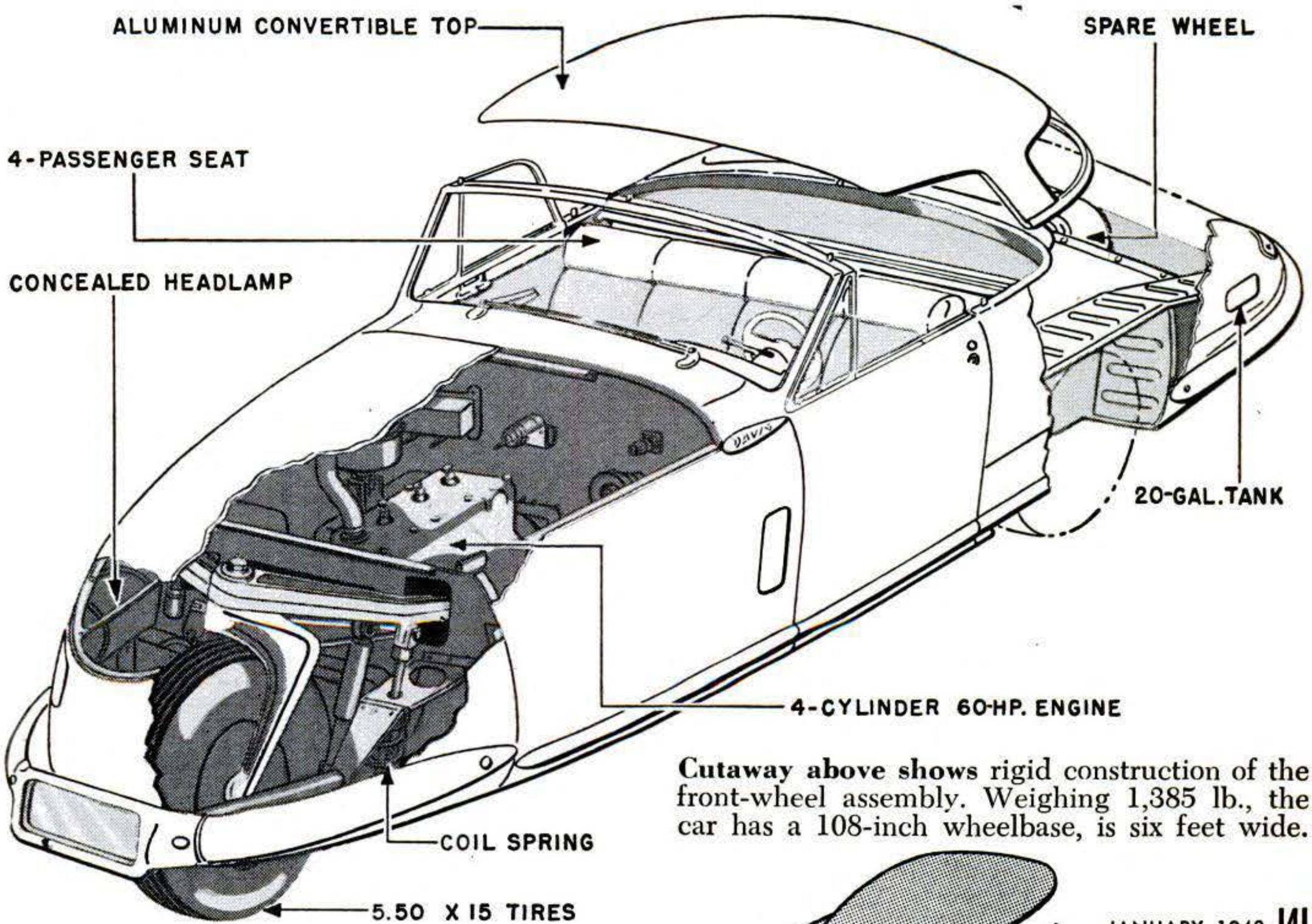
Tricycle Car Gets Around

IF YOU should want to go around in circles, the new three-wheel Davis car can spin you around in a 13-foot radius at a good clip. What's more to the point, this ability to make sharp turns is mighty handy when snaking through traffic and squeezing into tight parking spaces.

A low center of gravity, only 18 inches above the ground, plus a single nose wheel that turns 45° explain the car's unusual maneuverability. Not only handy in traffic, it is fast on the open road—the Hercules engine zipping it along at more than 100 miles an hour. Four-point coil-spring suspension and hydraulic oleo shock absorbers make for a smooth ride even at high speeds. The cantilever top, supported entirely from the rear, is made of reinforced aluminum.

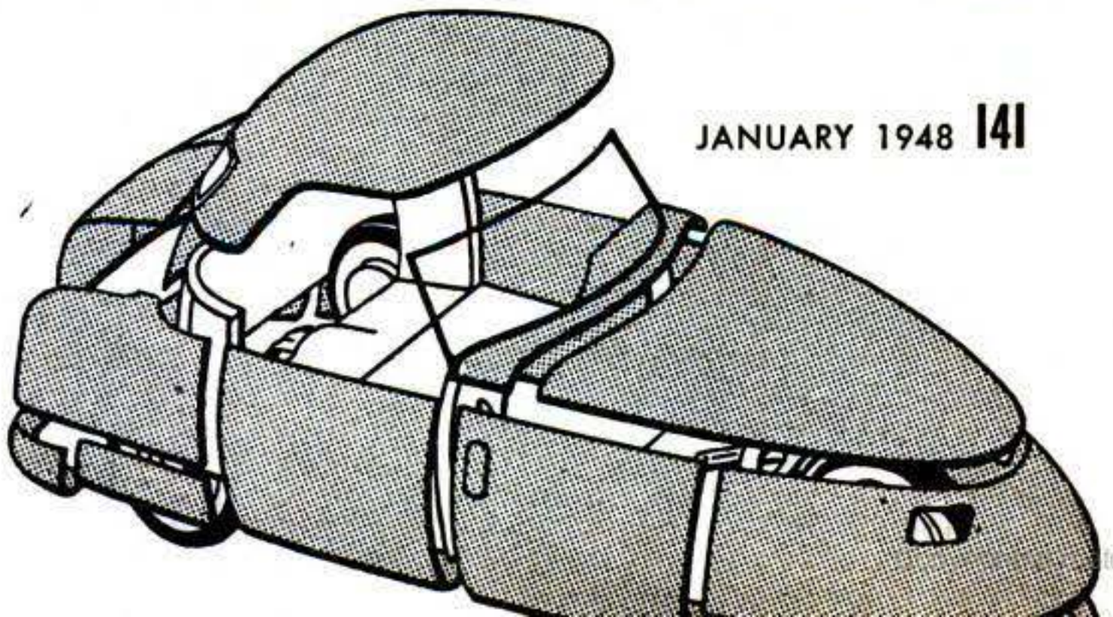
Although the car is not in full production, Gary Davis, of Los Angeles, hopes to set up low-cost assembly lines in key cities and sell it for less than $1,000.

A foursome fits cozily in the 64-inch wide seat. Nose wheel is set 2° off vertical to give a better road grip. Engine is 4-cylinder, 60 hp.



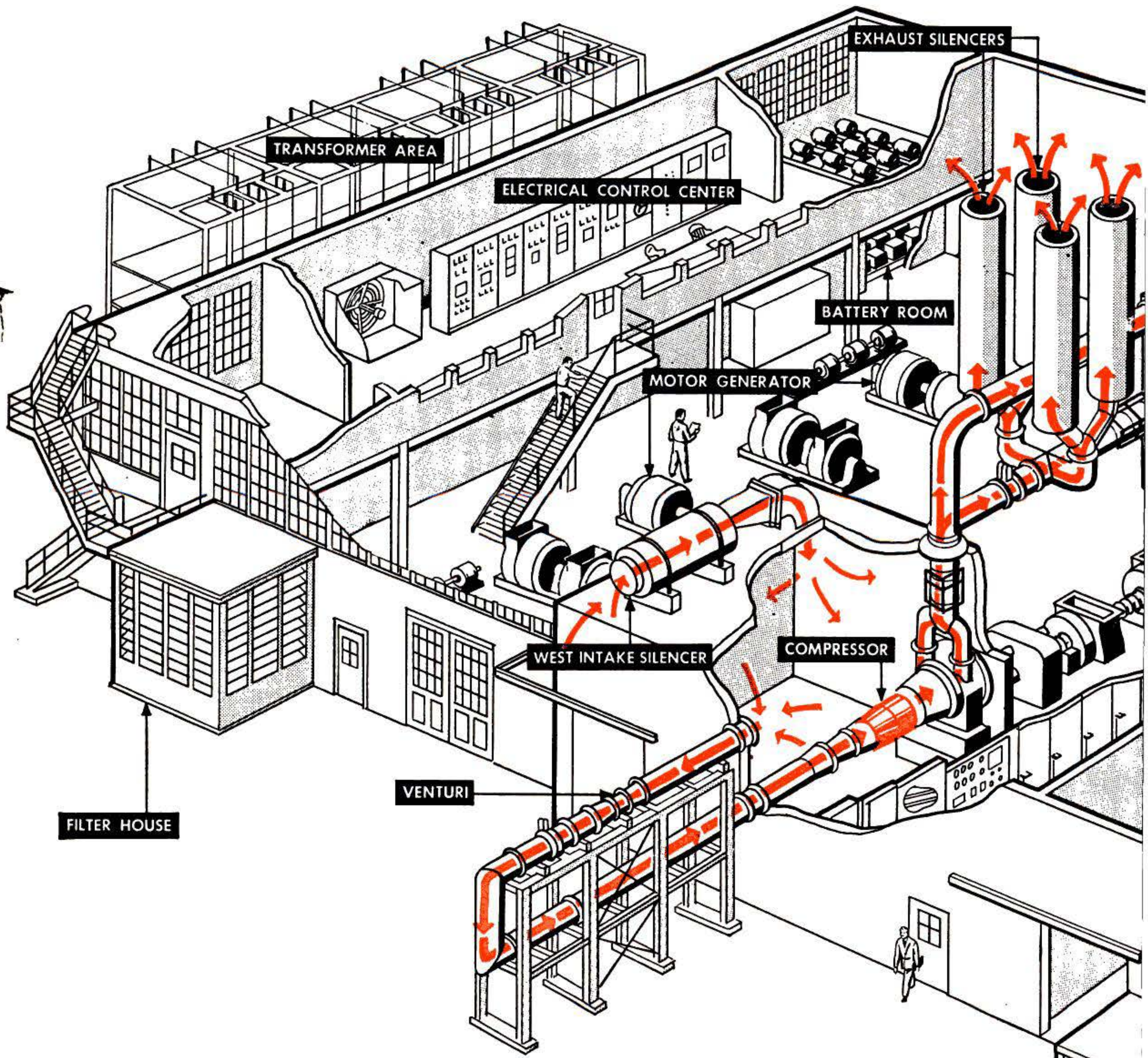
Cutaway above shows rigid construction of the front-wheel assembly. Weighing 1,385 lb., the car has a 108-inch wheelbase, is six feet wide.

Body panels shown in drawing at right are attached by aircraft-type lock bolts for easy replacement in case of damage. Top is held in place by toggle bolts. Front and rear of car are protected by wedge-contour steel bumpers.



Twisting a Turbine's Tail

This indoor proving ground for tomorrow's giant aircraft engines will handle more powerful gas turbines than any yet built.



Covering a city block, this gas-turbine development laboratory could turn up enough power to supply Fort Worth, Tex. The intake setup in foreground is duplicated by another intake, top center, so two compressors can be tested at once. Red arrows show various routes of air in one unit. The flow can either be exhausted directly or pushed to burners under test; along the way, Venturis increase its speed. Even when both compressors are running, they can operate only one burner-turbine testing unit at a time. The burners guzzle 1,000 gallons of fuel an hour. At exhausts, silencers muffle the roar of escaping air and burned gases.

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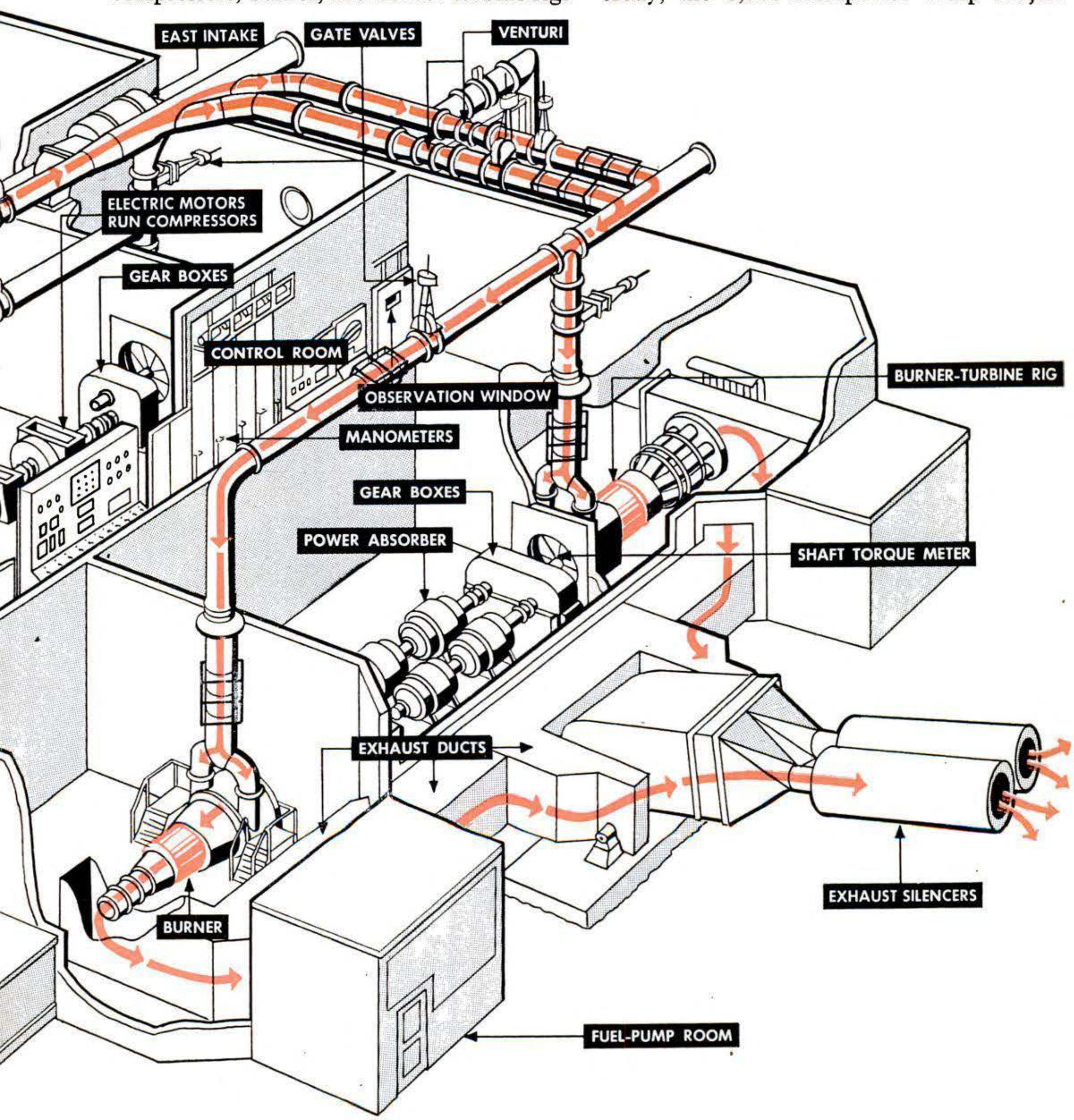
UNLEASHING their full power in rooms too hot for human beings, burners and turbines are put through tests that preview the engine performance demanded by the blueprints of tomorrow's mightier aircraft.

The roar heard throughout the building is the rush of air, 90,000 cubic feet a minute, that is gulped by the compressors, electrically driven to duplicate actual operation.

The scene is a development laboratory for gas turbines operated by the Wright Aeronautical Corp., at Wood-Ridge, N. J. Here compressors, burner, and burner-turbine rigs are tested separately, in the experimental stage. Giant 15-foot manometers—thermometerlike vacuum pressure gauges—give technicians a continuous visual check of the behavior of compressors and burners. Burner-turbine units are harnessed to the world's largest power absorbers, capable of measuring up to 20,000 horsepower.

Although the single gas turbines now under test utilize only half this capacity, they develop almost three times the output of the top reciprocating engine in aircraft use today, the 3,500-horsepower Wasp Major.



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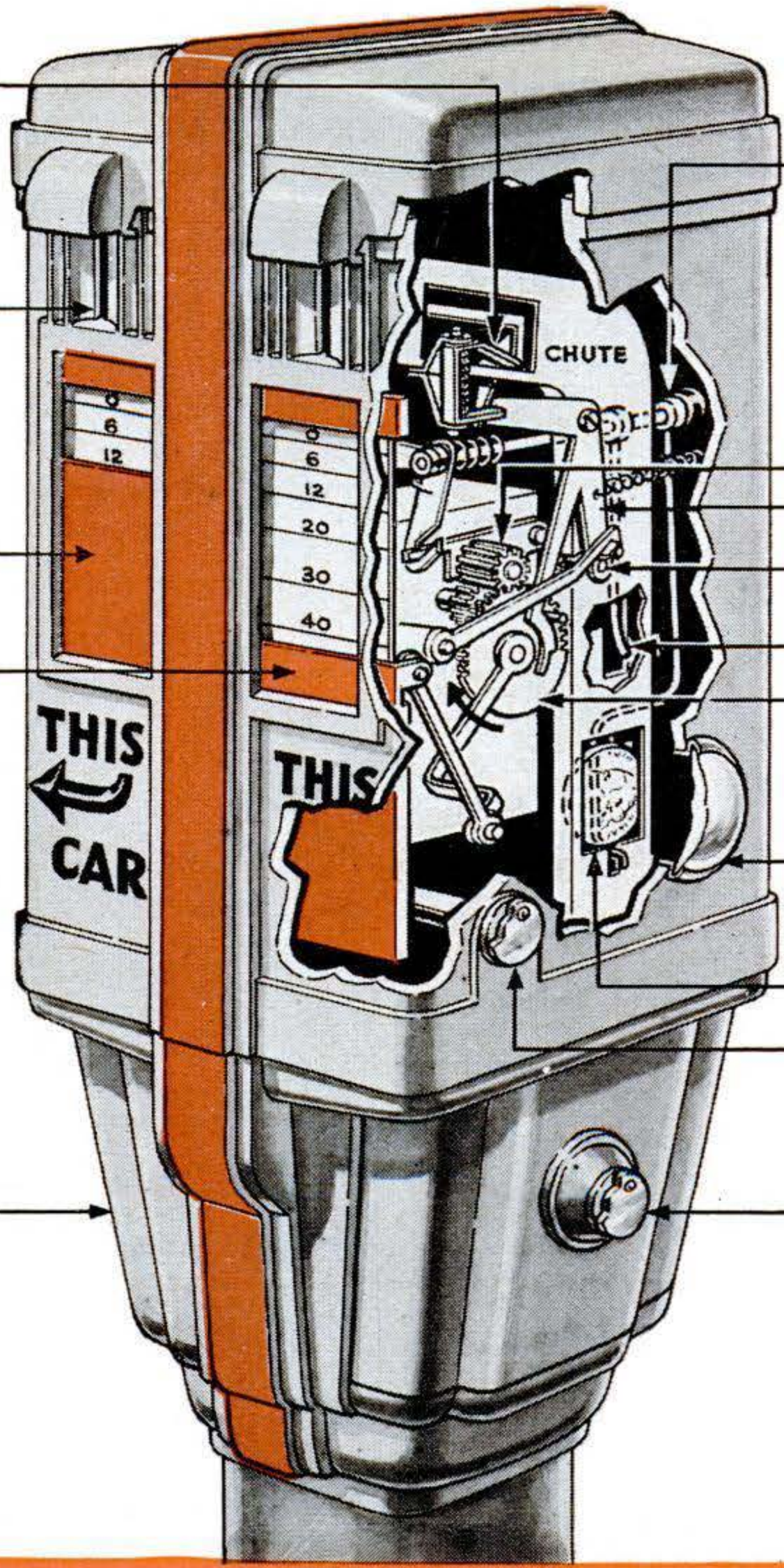


COIN DIVERTER SENDS PENNIES DOWN ANOTHER CHUTE IF MORE THAN 12 MINUTES OF PAID TIME REMAIN

COIN SLOT (12 MINUTES FOR 1 PENNY, 1 HOUR FOR 1 NICKEL)

SHUTTER MOVING UP AFTER INSERTION OF A PENNY INTO COIN SLOT

SHUTTER OF RIGHT-HAND UNIT MOVING UPWARD TO MEASURE TIME AFTER A NICKEL HAS BEEN INSERTED

BASE SERVES AS COIN BOX

WHEN ROCKER SHAFT MOVES, IDLER GEAR IS LIFTED OUT OF MESH ALLOWING SHUTTER TO FALL TO STARTING POSITION DETERMINED BY POSITION OF TIME-CONTROL LEVER

IDLE GEAR FOR CONNECTING MOVING CLOCK PINION GEAR TO SEGMENTAL GEAR

TIME-CONTROL LEVER

PIN MEASURES COIN, SETS TIME-CONTROL LEVER

WHEN A FALLING COIN STRIKES THIS WIRE, ROCKER SHAFT MOVES

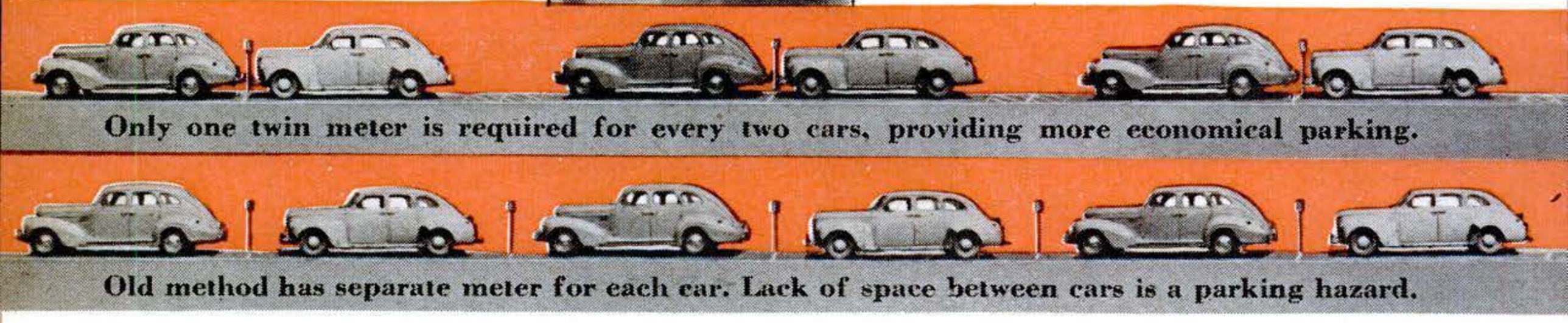
SEGMENTAL GEAR

COIN-VIEWING LENS

TRAP HOLDS NICKEL IN VIEW UNTIL NEXT COIN DROPS DOWN THE CHUTE

KEYHOLE USED IN WINDING THE 8-DAY CLOCK THAT POWERS BOTH METER UNITS

KEYHOLE FOR COIN BOX



Only one twin meter is required for every two cars, providing more economical parking.

Old method has separate meter for each car. Lack of space between cars is a parking hazard.

Twin Meter Parks Cars In Tandem

WITH this twin parking meter doing double duty along Main Street, the city saves money, the citizens have more parking comfort, and the curb looks less like a picket fence. Saving is not only in the initial investment, but maintenance and collection costs are cut in half, while meter receipts are doubled. Wholly automatic, the new-type meter is made by American-La-France-Foamite Corp., of Elmira, N. Y.

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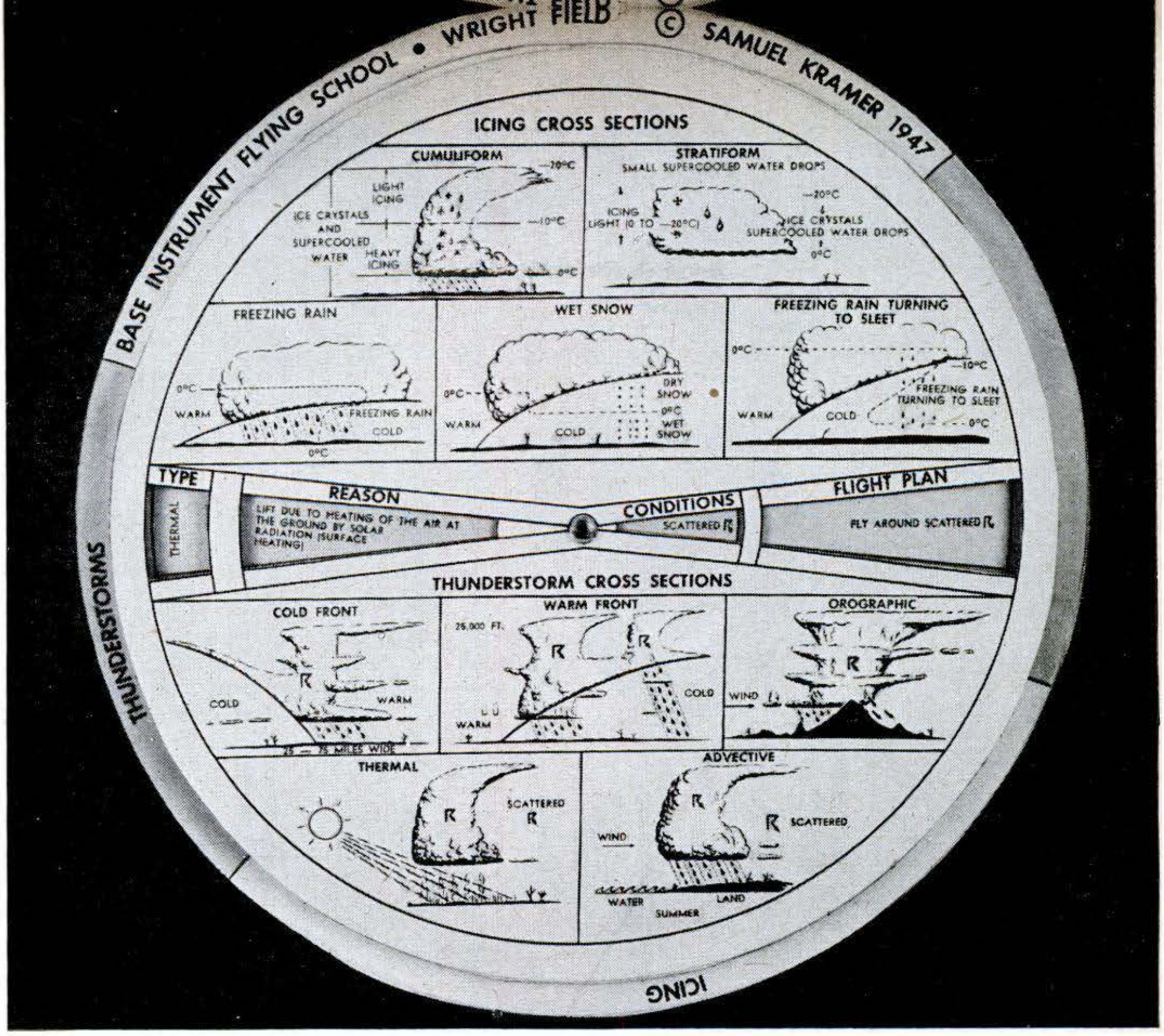

Pilots Can Now Dial Weather in the Sky

A PILOT need no longer depend on his memory to recognize weather hazards. The new "slide rule" shown above tells him what kind of icing clouds or thunderstorms he's up against, and what to do about it.

When a weather condition looming ahead has been matched with a picture, the pilot simply turns the dial until the corresponding key word appears in the "type" window at the left. This also brings into view a brief explanation of the condition, its intensity, and a flight plan to follow.

In this example, the pilot has identified a thermal disturbance and has dialed "thermal." Reading across, he finds that he should fly around scattered thundershowers caused by a rising column of warm air.

Developed by an employee of the Air Materiel Command, the device will be used both in actual flight and in training.

Tire Change Made Easy

USING this new tire changer, two men can take an aircraft tire off its rim in less than eight minutes. The wheel and tire are placed on a base with a threaded shaft protruding through the hub. Clockwise rotation of a drive bar screws down a stripper tool to depress the side wall of the tire. Next an "on and off" tool is forced under the bead. A counterclockwise rotation, as shown above, pulls the upper bead off the tire; the lower bead is similarly freed. The device is distributed by Air Associates, Inc., Teterboro, N. J.

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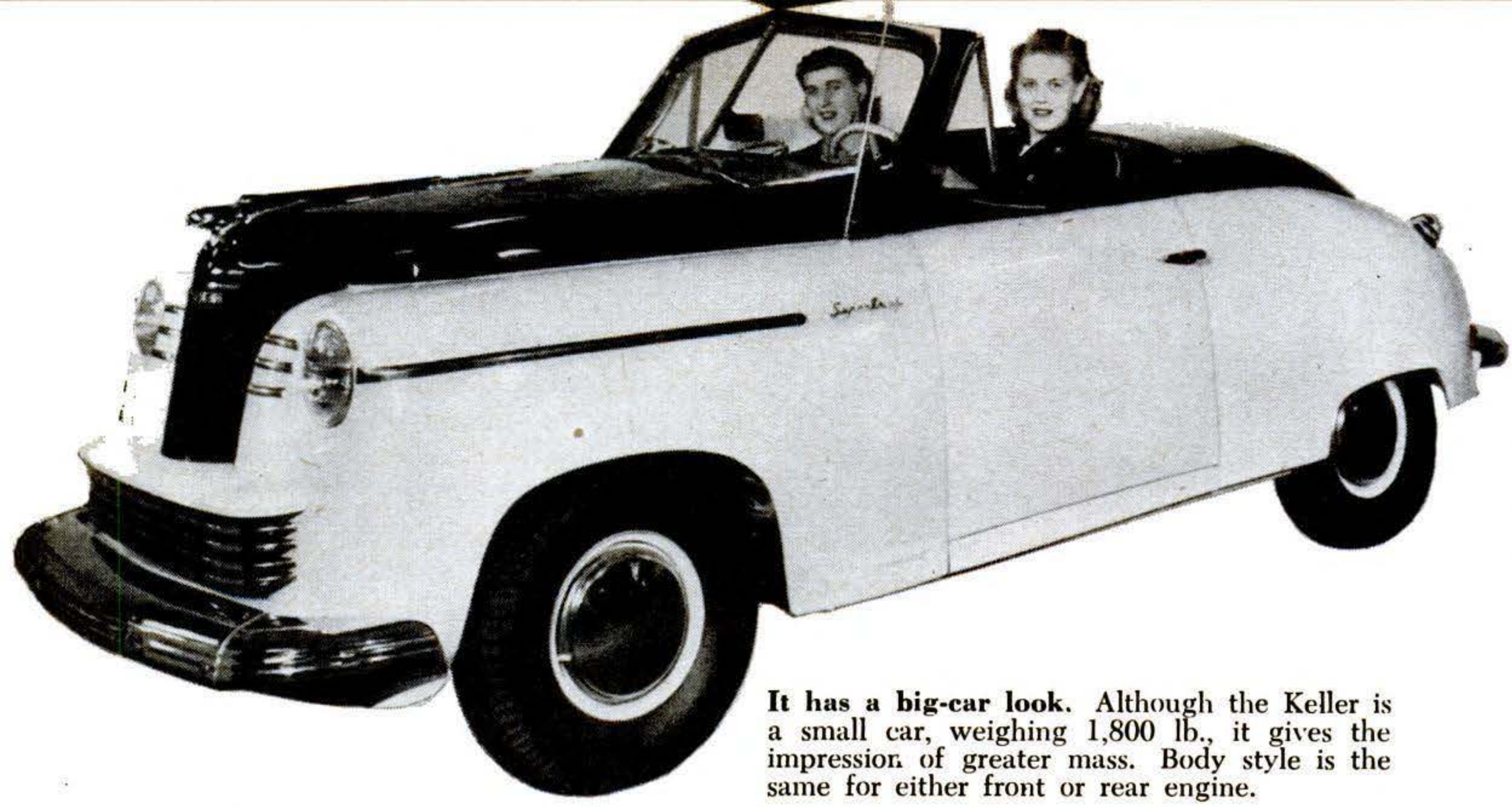

It has a big-car look. Although the Keller is a small car, weighing 1,800 lb., it gives the impression of greater mass. Body style is the same for either front or rear engine.

Engine Is Where You Want It

DO YOU want your auto engine in the front or in the rear? Would you like both a hard and a soft top for alternate winter and summer use? With the new Keller car, planned for 1948 production, the choice is up to the customer.

Another boast of this new entry in the low-price small-car field is "cradled-in-rubber" wheel suspension, with all four wheels independently sprung.

With this device, the wheels are pulled gently over road bumps instead of being pushed abruptly into them. It consists of rubber torsion springs bonded to both the inner steel core and the outer steel shell between which they are sandwiched. Since the central core remains static, the elasticity of the rubber controls the movement of a trailing arm rigidly attached to the outer shell. This method of suspension lowers the center of gravity, yet leaves a road clearance of 10¼ inches.

The Keller is designed in two models—the Super Chief and the Chief—planned to sell for less than $1,000 f.o.b. at the factory, Huntsville, Alabama. Both are convertibles built on a 92-inch wheelbase. Another model, a five-passenger, front-engine station wagon, will receive production priority because it requires less sheet steel.

The Super Chief is powered by a 49-hp., four-cylinder engine designed for a top speed of 70 m.p.h., and getting about 35 miles out of a gallon of gas at normal driving speed. The Chief also will have a four-cylinder engine, but of only 25 hp. Engines of these sizes are made both by Hercules and Continental. When the engine is located in the rear, space under the hood is used as a luggage compartment.

Keller engineers have hit on a simple way to switch engine location. When the engine is to be mounted in front, the differential is detached from the rear drive assembly, turned to face in the opposite direction, and installed at the rear with rubber shock mounts. The rest of the assembly is moved forward, the gear box is lowered, the frame strengthened, and a propeller shaft added.

Other features include pressure lubrication, downdraft carburetor, automatic choke, hydraulic brakes on all wheels, a clutch-pedal starting switch, and flush seal-beam headlights. A turning radius of only 14 feet, nine inches, makes parking easy.

An assembly job rather than one of wholly new design, nearly 90 percent of the Keller is made of parts already in production for larger cars. Thus the company expects no difficulty in obtaining spare parts.

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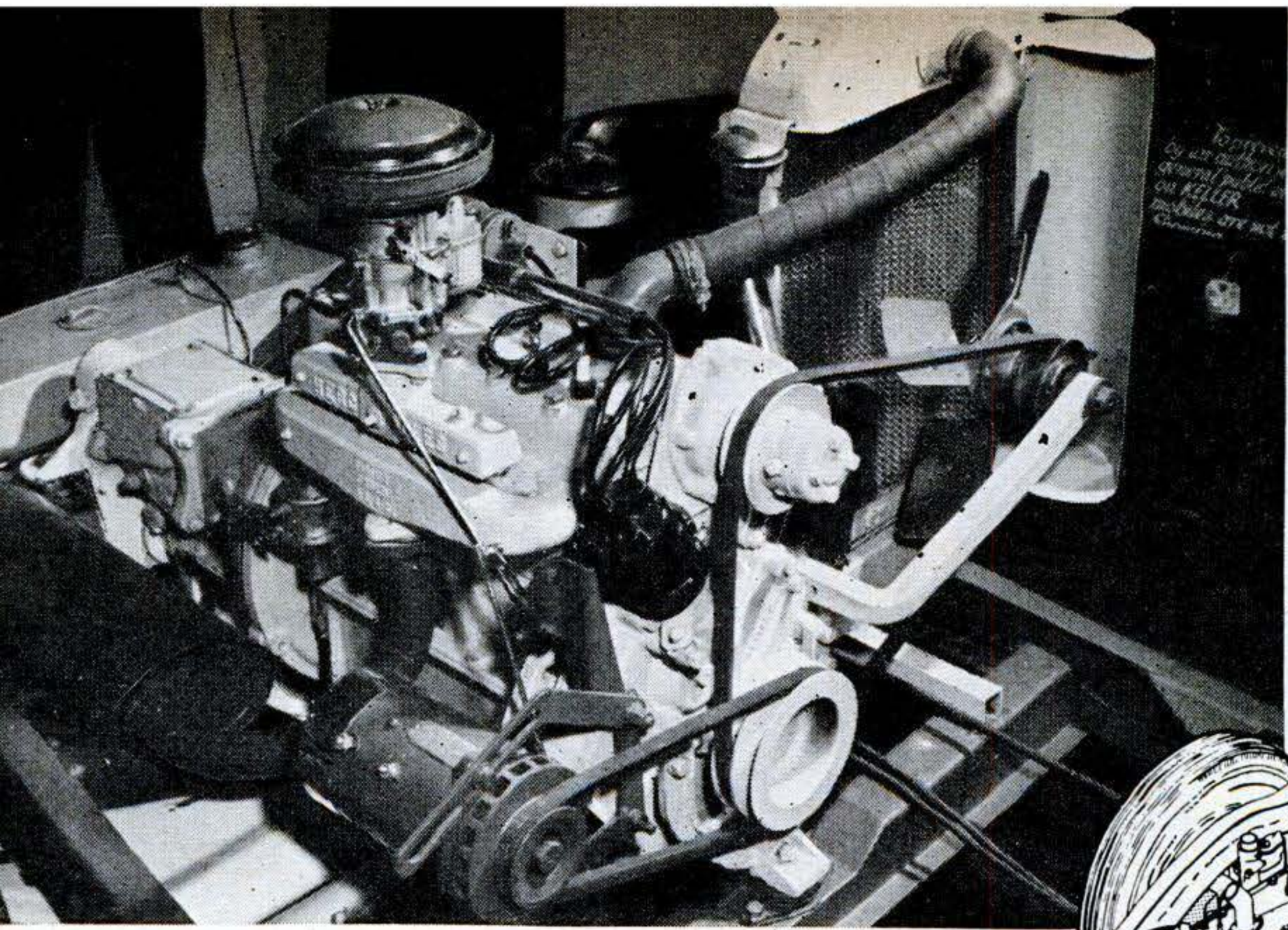
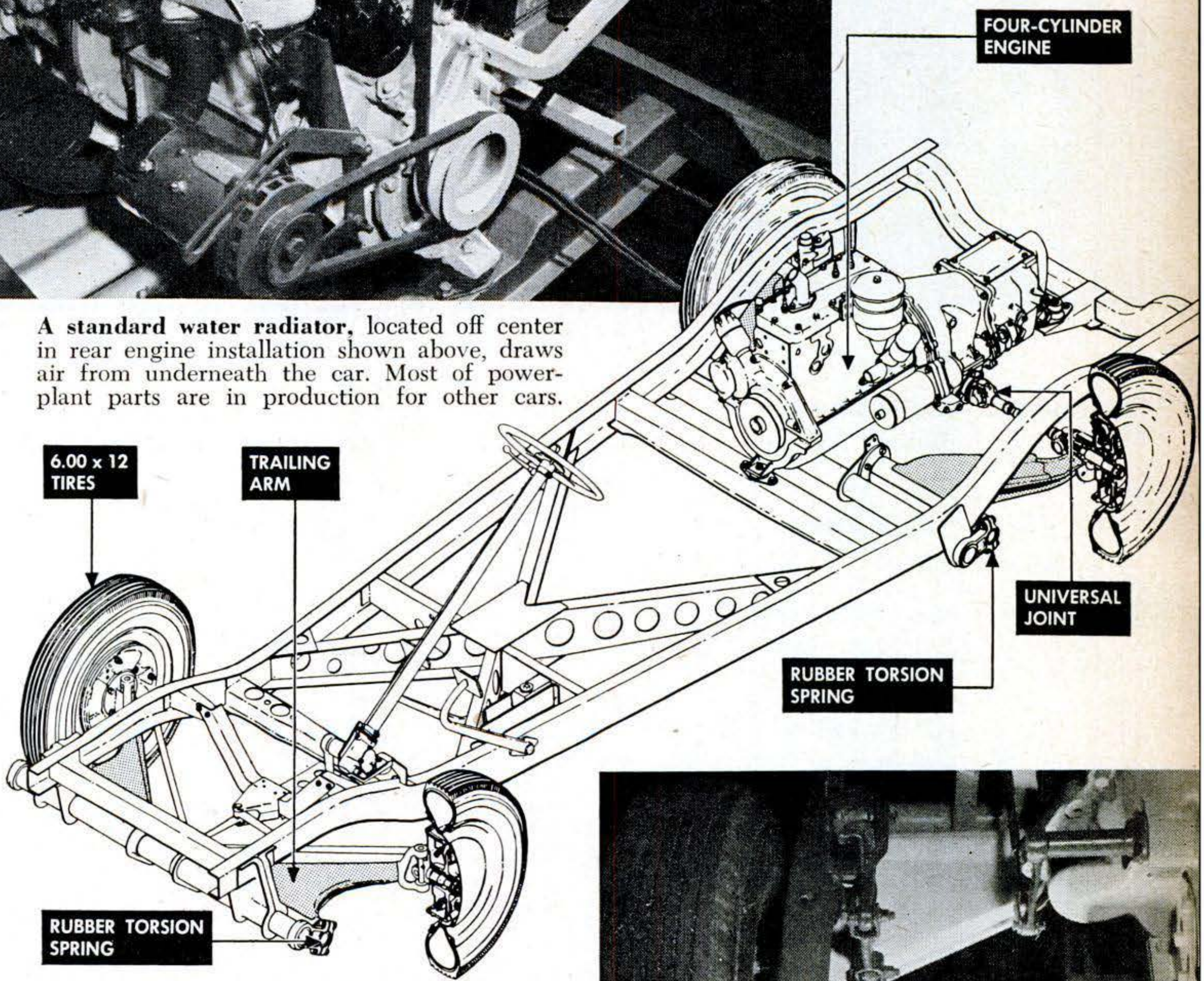
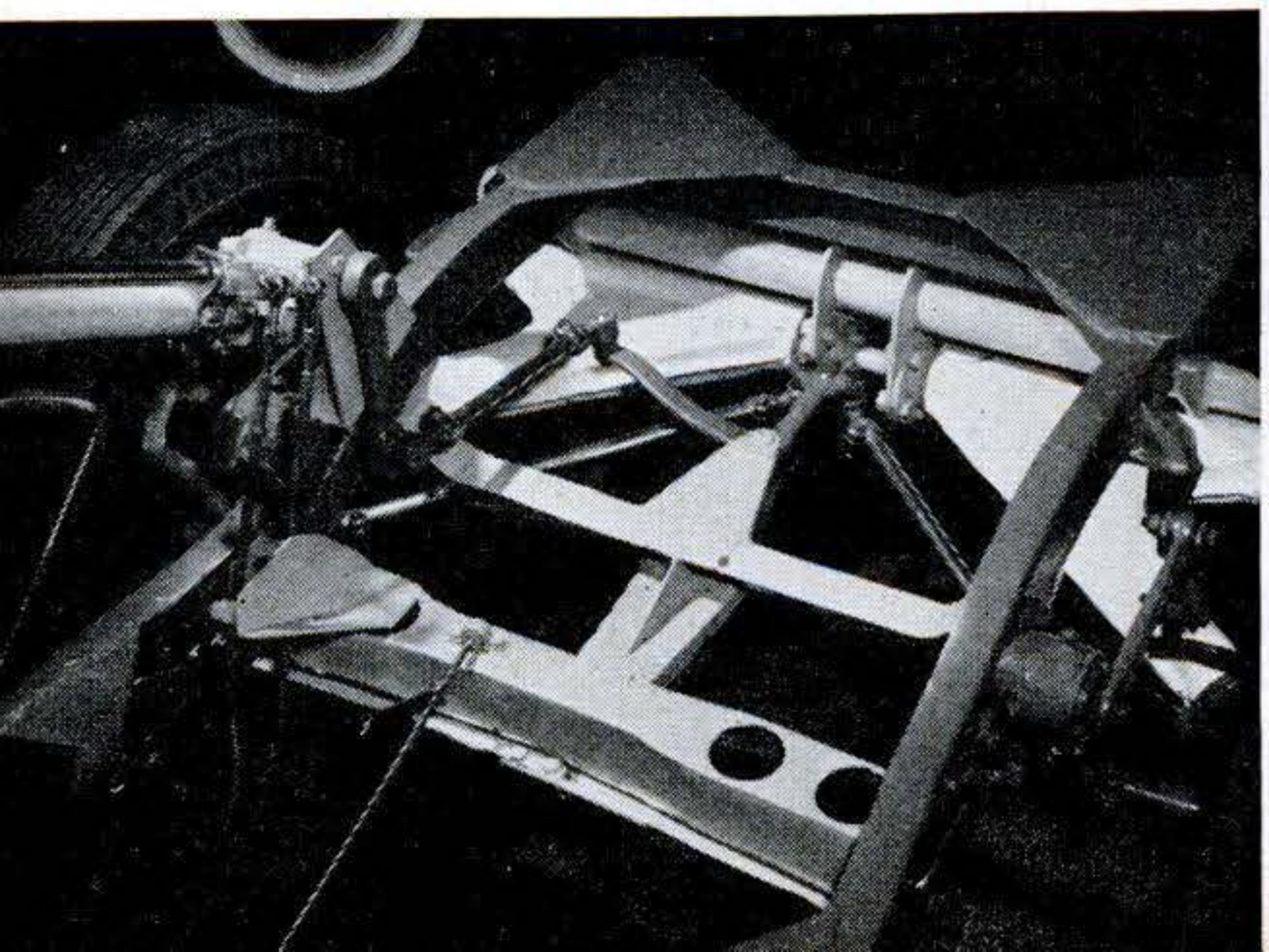
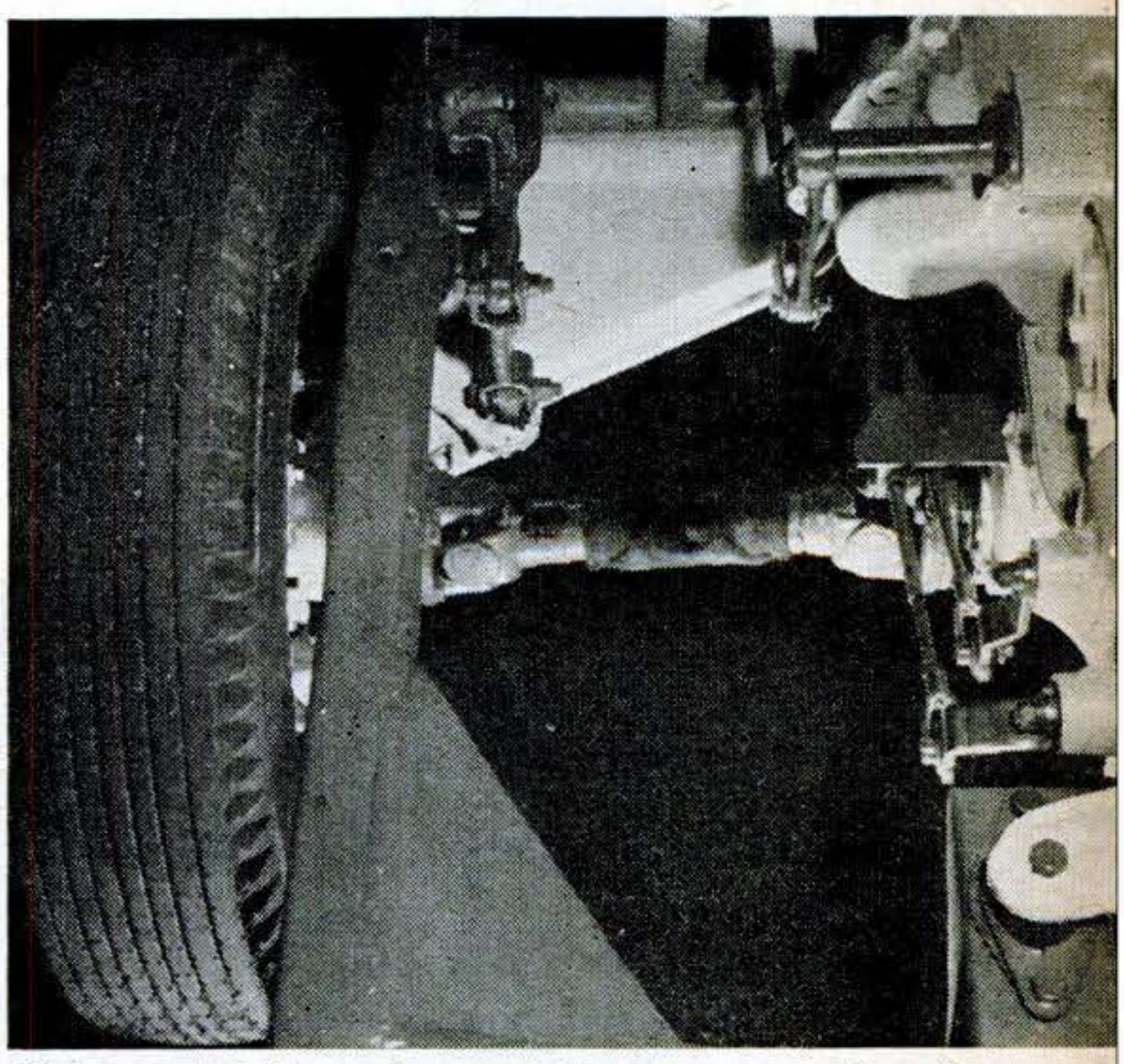


A standard water radiator, located off center in rear engine installation shown above, draws air from underneath the car. Most of power-plant parts are in production for other cars.



Trailing-arm suspension units, identified above, that lead from the rubber torsion springs to the wheels are evident in front-end view below.





Universal joint, above, delivers power directly to the wheel when engine is in rear. For front engine, a propeller shaft must be added. The rear wheels are independently suspended.

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Static from the Stars

Because a radio ham heard strange sky noises, we may get better FM and television—and learn more about our universe.

By Herbert Yahraes

Drawings by Ray Pioch

WHEN young Grote Reber was a high school sophomore, he operated 9GFZ in Wheaton, Ill., and tacked so many recognition—QSL—cards to his bedroom walls that the plaster cracked and his parents cracked down. When not communicating with El Paso, Arequipa, Capetown, Prague, and other points, he designed equipment to communicate with them even better. Nobody who knew him then will be surprised to learn that he is still in radio—listening not to the chatter of hams, but to mysterious and bothersome radio waves that come from the heart of the Milky Way.

Reber—the first *e* is long, as in *receiver*—has designed and built a huge radio mirror that traps radio waves from the stars the same way that an ordinary telescope mirror traps light waves. The radio waves can be used for the same job—to explore the universe. After 10 years of experimenting with the mirror in his family's yard in Wheaton, where the ignition system of every passing automobile broke into the stellar broadcasts, Reber has sold it to the United States Bureau of Standards and has signed on to operate it as one of the Bureau's top radio physicists. Now, in a big, quiet field in Virginia, 40 miles west of Washington, the 35-year old former ham is ready to work full time decoding the messages from space.

The Bureau expects these messages to help answer at least one question of immediate, practical importance: Where shall FM and television stations be located? They may also influence the design of new high-frequency equipment. For Reber's telescope already has shown that radiation from the great beyond comes in on the same frequencies as those used for FM, television, and radar. It is, in short, cosmic static, and on these frequencies it can be as upsetting as ordinary thunderstorm static on the much lower home-broadcast band.

Military Use Foreseen

Furthermore, Reber's big mirror may have some bearing on any future war. During World War I, pilots commonly hid in the sun, either to escape enemy planes or to pounce unexpectedly upon them. Radar spoiled that tactic in World War II. But static comes from the sun as well as the stars, and sometimes floods the atmosphere with strong radio waves. If these great outbursts can be predicted—and Reber's technique makes it possible to study them more carefully than ever before—planes will be

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Tomorrow's telescopes may be huge mirrors that gather faint electronic radiations from stars.

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Grote Reber is shown with his great "mirror." He is atop a 20-foot scaffold adjusting the receiving equipment (arrow) for 160-megacycle tests, the first frequency he used successfully.

able to zip into an enemy's territory while his radar is temporarily jammed.

Neither Reber nor anyone else at the Bureau even hints that this possibility had anything to do with his being hired, but it is a fact that the armed services supply the money for many a radio research project, including this one.

Beyond these practical aspects, the radio telescope is expected to help chart the shape and size of the Milky Way, which is our part of the universe; to probe into the mechanism of the sun; and to identify cosmic material too dark to be analyzed by the ordinary spectroscope.

"Telescope of Tomorrow"

It is one of the developments Dr. Otto Struve had in mind when he declared recently that "electronics will dominate the next 50 years in astronomy much as photography dominated in the past 50 years." Dr. Struve, eminent astronomer and honorary director of Yerkes Observatory, describes Reber's apparatus as the "telescope of tomorrow" and believes that because of it and other new electronic devices "the construction of larger telescopes may no longer be the primary concern of the astronomer."

Reber's apparatus looks like a gigantic parasol made of glistening sheet iron. This mirror captures electromagnetic energy the same way the mirror of an ordinary reflecting telescope captures light, and then focuses it on a drum 20 feet above the mirror's center.

Inside the drum are a pair of cone antennas, which convert the stellar radiation into alternating current. This is fed from the cone tips to a five-stage amplifier and then rectified. The resulting direct-current voltage passes into a recorder, which charts its intensity.

Sweeps Out Path in Sky

Just as in other big telescopes, the mirror is mounted on an east-west axis so it can be pointed to an angle of declination between minus 32.5 degrees and plus 90 degrees along the north-south meridian. As the earth rotates, the telescope sweeps out a path in the sky along the angle the observer has chosen.

Down in the housing at the base of the telescope, a pen automatically draws a line on a strip of paper—just as in the machines used to record electric waves from the heart or the brain. The chart moves six inches an hour. The line is straight until radio waves from outer space are intercepted; then it moves up, the height of the move measuring the intensity of the radiation.

People who don't know anything about radio, except that if they dial 770 they get WJZ, often ask Reber, *What do you hear from the stars?* The tall, slim physicist grins and says he doesn't hear a thing. He points out that radio waves themselves are not sound: they are electromagnetic energy. They can be turned into sound, all right, or they can be used to draw lines on a chart. "If you want to get the Rose Bowl or a performance of Carmen," he says, "it's sensible to turn them into sound; if you want to study the universe, it's sensible to let them draw lines."

Once in a while, though, Reber does plug in a headset. What he gets is pretty disappointing. "The music of the spheres," he says, "is nothing but a hiss."

The sun's basic message is also a hiss, but riding on top of it, as disturbances flare up in the solar atmosphere, come sudden puffing and swishing noises. These may last only a second or less, or they may overlap, giving rise to a grinding sound. That's

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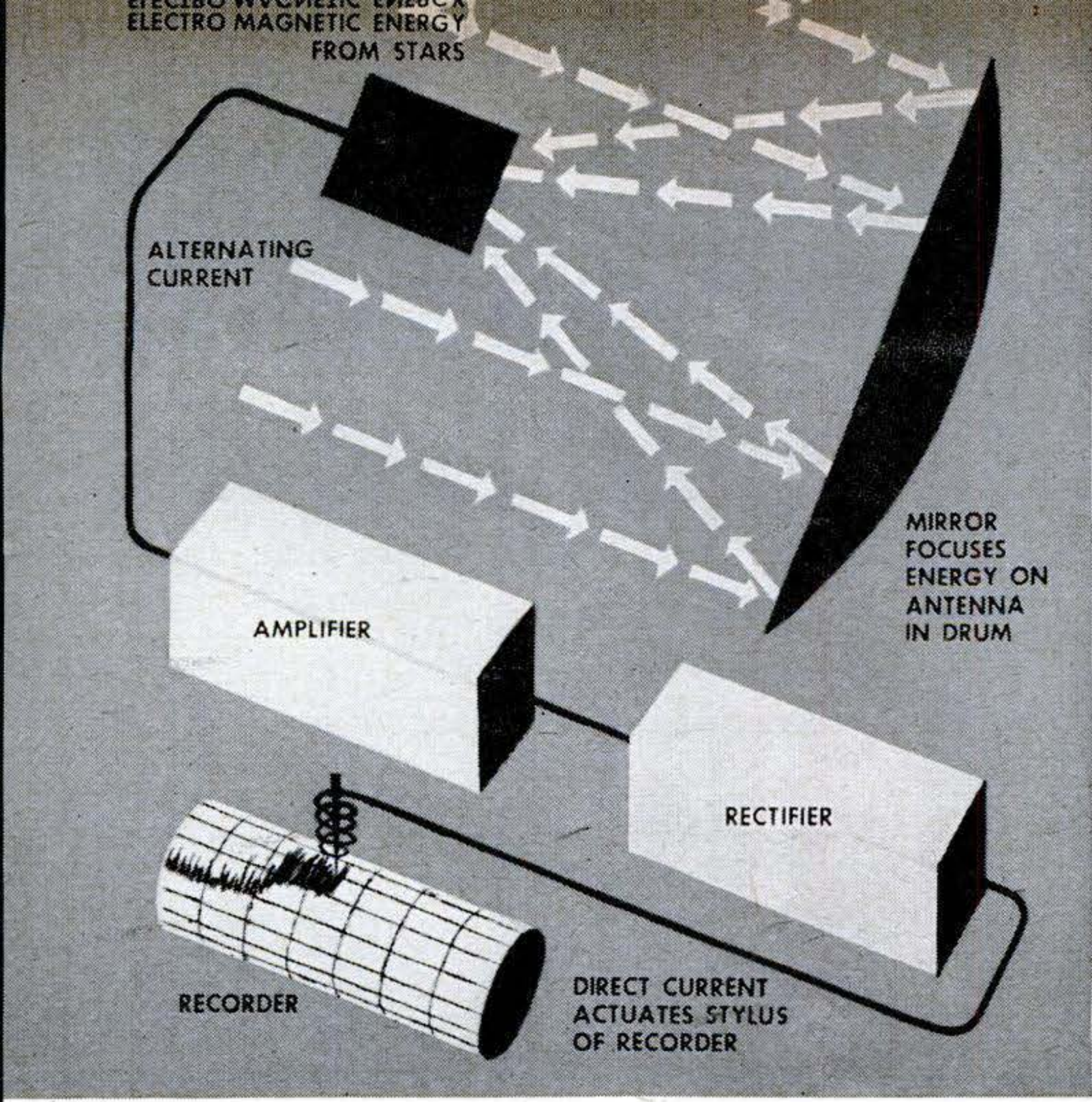

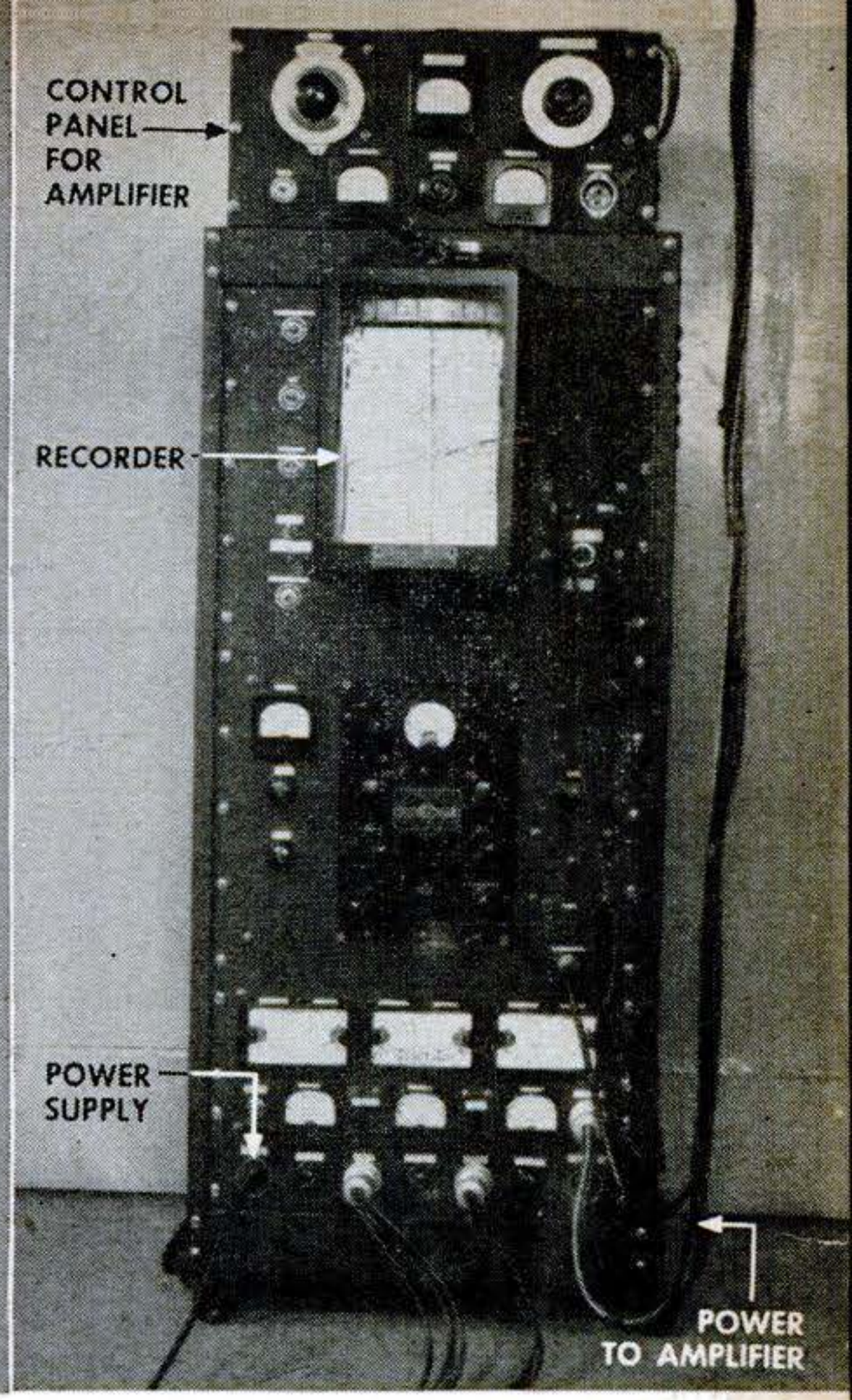

Conversion of radiation into AC is shown in diagram at left, above. Actually, both amplifier and rectifier are inside the little knob that sticks out from drum at focal point. At right, above, is the laboratory apparatus. Top holds controls for amplifier; center, automatic recorder that charts time and intensity of radiation reception; bottom panel, power supply unit.

when a television picture is likely to get the heebie jeebies.

This difference between solar and stellar noise is one of the reasons Reber doubts that the two phenomena have exactly the same cause. Another is the fact that the sun and the Milky Way come in with the same intensity on one frequency but with widely varying intensities on others. If the cause were the same, he says, we would not expect the radiation to be of the same strength since, after all, the sun is much closer than the Milky Way. But we would expect the ratio of intensity to be uniform, no matter what frequency the waves came in on. However, it isn't.

Reber has been tuning in the heavens for 10 years, but, until recently, he was unable to give full time to the job or use certain refinements in his mechanical and electronic equipment. What started him off was a series of scientific reports by Karl G. Jansky, of the Bell Telephone Laboratories, that were published in the *Proceedings* of the Institute of Radio Engineers. The first of these appeared in 1932 when Reber was studying at the Armour Institute of Technology. Jansky had set up a rotating antenna at Holmdel, N. J., to study the direction and intensity of ordinary static and had been surprised to find himself recording not two kinds of static but three. The first was from local thunderstorms, the second from distant thunderstorms. With scientific caution he described the third kind as "a steady hiss-type static of unknown origin." He thought at first that it was coming from the sun but later concluded that the Milky Way was generating most of it.

Years of Research Ahead

Out in Illinois the young student, Reber, sought the answers to questions posed by Jansky's findings from physicists and mathematicians at the University of Chicago. They couldn't satisfy him. And when Reber proposed to make the subject his research project, they pointed out that he might have to work on it 10 years. "Universities," he says today, "are geared to get you a Ph.D. in three."

So Reber took a job and plunged into weekend and night-long research on his own. His goal was equipment sensitive enough to determine just where the heavenly radio noise was coming from and how

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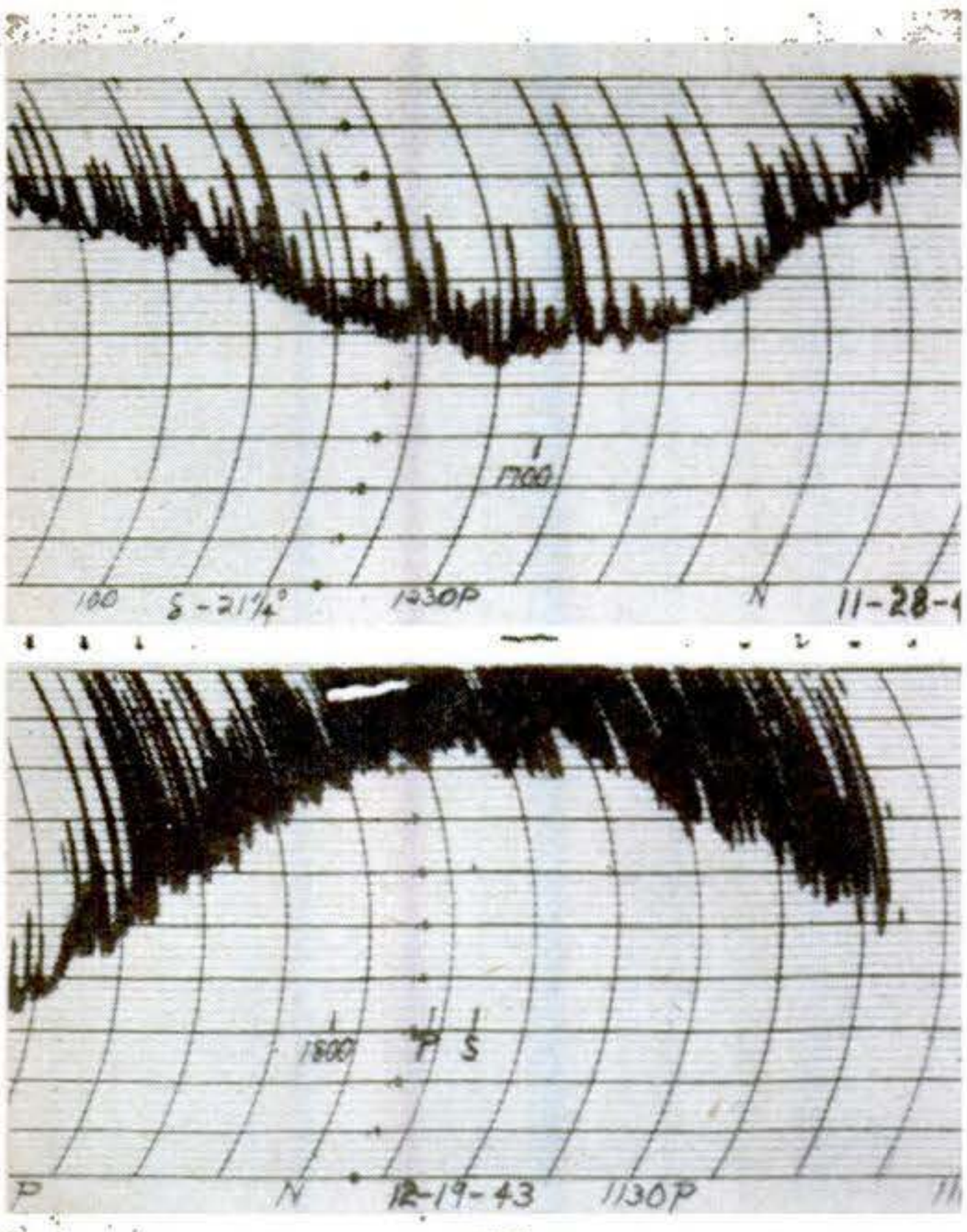
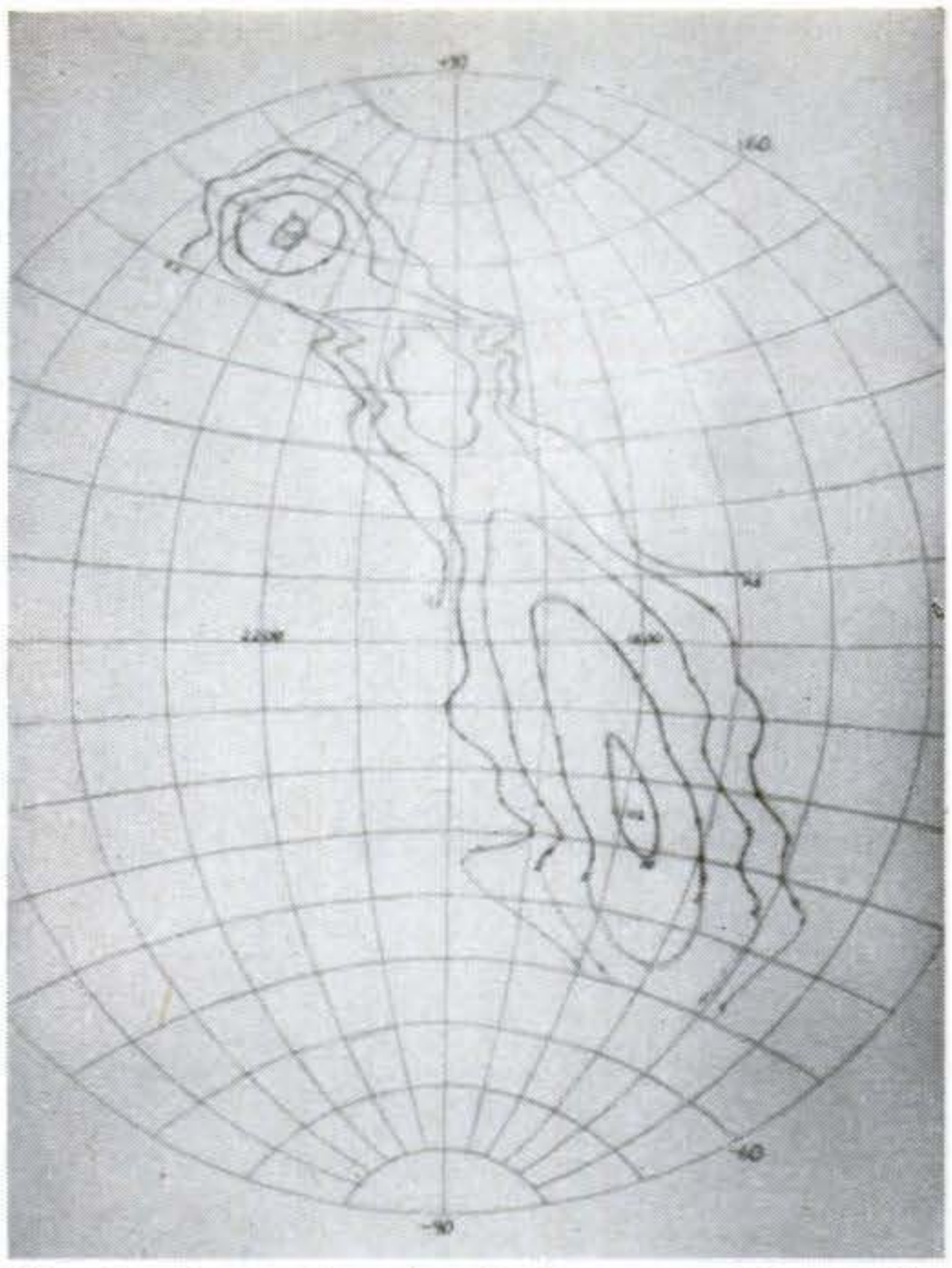


Charts showed great radiation rise when sun passed through the Milky Way and "telescope" picked up both solar and stellar radio waves at once. At top, peaks come at ends; below, in middle. Sharp black peaks are from auto ignitions.



Plotting intensity of radiations according to the direction from which they come produces these "contour lines," connecting points of equal intensity, on map of northern Milky Way. "Peak" at lower right center is Sagittarius.

strongly. He kept thinking about ordinary telescopes. Why not build one for radio waves, using a big disk as its mirror and an antenna as its "eyepiece?"

The mirror was fairly easy to make. He bolted together nine pie slices of sheet iron for the middle of it, and added 36 lengths around the circumference. He fastened it to wooden ribs with screws.

The electronic equipment, particularly the amplifier, was tougher. He tried out a frequency of 3,300 megacycles. He got nothing, and he got nothing on 910. At these extremely high frequencies his original apparatus was too insensitive to pick up the waves from space.

Finally Makes Contact

He kept trying. "You know how it is," he says. "You start off cheaply and you keep figuring that if you spend just a little more you may get somewhere." What Reber spent would have bought him three automobiles.

One bright midnight in October of 1938, 15 months after he had completed his first model, he pointed his telescope at the Milky Way and then hurried into the cellar of his home to watch a little meter he had rigged up. It looked like the speedometer of an automobile. The frequency was 160 mc. As he watched, the needle slowly rose from the base line. The young engineer plugged in a headset. From the direction of the constellation Sagittarius came a hiss.

Eventually, Reber could afford an automatic recorder to take down the stellar broadcasts, but in those early days he had to rely on the meter. Night after night he would take readings—every minute, beginning at midnight. He couldn't get accurate results before then because the Reber home was only two and a half blocks from the railroad station and a block from a parking lot, and every time a car passed he could hear all its spark plugs popping. Even after midnight he got interference from ignition systems and electric switches. He made his readings every minute on the minute until six in the morning; then he would grab a couple of hours' sleep and drive into Chicago to design electronic equipment, first for Stewart Warner and then for Belmont.

At first the neighbors pestered him with questions about that big shiny "shaving

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mirror" perched high above the rhubarb patch in the yard, but after a while Reber could tell when there were strangers in town because only strangers would stop to look.

The automatic recorder was the answer to Reber's need for more sleep. It also enabled him to chart the radiation more accurately. The waves didn't come from every part of the sky, nor were they of uniform intensity. Reber would make several charts of each angle of declination under study—one chart a night—and then plot them on a globe representing the sky of the northern hemisphere.

Such studies may explain the nature of the Milky Way. Classification of the Milky Way as a type of spiral nebula, says Dr. Bart J. Bok of the Harvard College Observatory, is one of the outstanding problems confronting astrophysicists. They've been stymied so far, partly because we are inside this great galaxy—like a bug in a watch case—and so can't get a good look at it, and partly because some of the sections we can look at are obscured by huge, dark clouds of gas and cosmic dust.

Here's where the radio telescope comes in. Reber's work indicates that the greatest source of radiation is in the direction of the Milky Way constellation of Sagittarius, or the Archer. Perhaps, then, this is the center of the nebula, 10,000 light years away. Other main sources are in the direction of Cygnus, or the Swan; Cassiopeia, which forms the big W; and Canis Major, where the Dog Star is. Perhaps these are the arms of the spiral.

More Observations Needed

Many more observations must be made before the picture becomes clear. Fortunately, at the Bureau of Standards Reber can work a lot faster. His "telescope of tomorrow" is now mounted on a motor-driven turntable so that it can sweep a path along one angle of declination in a few minutes. Now he can make as many charts in two weeks as he used to make in a year.

The offer from the Bureau of Standards came just as Reber was getting discouraged. Wheaton was a lovely town, but it had too many automobiles. Their ignition systems scrawled over his charts at night, and daytimes, when he tuned in the sun, they made a record that looked like a fringe of hair standing straight up around a bald-man's pate. For good work he needed a location fairly free of man-made electrical disturbances. So his turntable, delivered just before the war, lay in the cellar while he tried to get financial backing for a full-time study in some isolated spot.

Raising Money a Problem

First he approached the universities. He went to his friend, Otto Struve, of Yerkes Observatory, of the University of Chicago. Struve was all for taking over the project, but in the end he couldn't find the money. Harlow Shapley, of Harvard, said Reber's work was wonderful, but Harvard's money, too, was all tied up. The young engineer got similar answers from distinguished scientists at other universities. But they all added: "Be sure to give me as reference."

Fortified with references, Reber next tackled such people as officials of Belmont Radio, Bell Telephone, Sperry Gyroscope, Bendix, Stewart Warner, and other companies making or using electronic equipment. They all seemed sincerely interested, and they all said, in effect, "Now if you will just sit down and help us get our money back on this thing—." Reber said it might be years before he could do that.

The break came a year ago last fall. Reber was in the audience when Dr. E. U. Condon, director of the Bureau of Standards, told a Chicago convention of elec-

This German Wurzburger radar antenna has been adapted for use with Reber's equipment for receiving solar radiations and set up at Sterling, Va. Housing is German prefab steel shack.

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tronics men about the Bureau's policy—to undertake research that commercial companies couldn't do well or couldn't do at all. Reber went home and wrote Condon that that was the sort of research he had been doing, too. Back came a letter asking if Reber would invite two Bureau physicists to look over his apparatus. Reber said sure.

The visit was set for November 20 but the government men arrived a day late—three of them instead of two. It was a miserable day—cold, rainy, not a sign of the sun. Nevertheless, Reber pointed the telescope at where the sun was supposed to be, and the four men huddled around the automatic recorder in Reber's cellar. Even Reber was amazed at what happened then. The pen recorded solar radiation far stronger than any he had previously picked up. He listened in and heard rapidly changing puffs and swishes and grinding noises, all riding on top of a steady hiss. The sun, though entirely hidden from sight, was certainly putting on a show.

The visitors were impressed. But was Reber sure it was the sun? He turned the telescope to other parts of the sky, and the puffing and swishing faded out. Turn it back, they said. In came the solar static as strong as before.

A few days later, Washington sent Reber a job application blank.

Hobby Goes on the Pay Roll

Reber signed on with the government last June to work full time at his hobby. Since then he has dismantled his equipment, shipped it east, and installed it at the Bureau's radio propagation laboratory at Sterling, Va.—a great, flat, lonely field stretching away from a narrow red clay road and dotted with a few shacks and many antennas. It is a pretty good substitute, he thinks, for the desert he longed for when Wheaton spark plugs popped all night.

He has also adopted two German Wurzburgers to his work. A Wurzburger is an early warning device, a type of radar, made of steel mesh 25 feet in diameter. It resembles a hollowed-out quarter of an orange. Fitted with electronic equipment devised by Reber and trained on the sun by automatic control, the Wurzburgers take care of the solar radiation part of the program while the "telescope of tomorrow," more suitable for Milky Way investigations, probes the rest of the universe.

Working full time and with the help of other Bureau scientists, Reber hopes within a few years to collect data that will tell broadcasters what frequencies they can expect to have jammed by cosmic and solar static, and how close together FM and television stations ought to be located if the public is to get the fullest benefit from them. He hopes to learn, also, where these heavenly broadcasts originate, and why.

To Seek Celestial Elements

Right now he has these facts to go on: The cosmic radiations come from the direction of certain points in the Milky Way; with a few exceptions, he receives none from bright stars in other parts of the sky. So he concludes that the broadcasts arise in or behind the dark, gaseous clouds that form half of our supergalaxy. If so, why? We might know if we could learn what these clouds are composed of. Under certain conditions, each element sends out radiation of a certain frequency. The problem is to find the frequency and to build a set that will receive it. Reber is now finishing a set, to be used with his mirror, for tuning between 1,400 and 1,450 megacycles. "A smart Dutchman at Yerkes," the astronomer H. C. Van de Hulst, has told him that there he may find hydrogen. If he does, he will then look for other elements.

This will still leave the final cause of the celestial broadcasts up in the air—or, rather, up in the empyrean where they come from. Perhaps they are one of the results of atomic fission in various cosmic laboratories. If that is so, the radiation has lost most of its energy before hitting the mirror of tomorrow's telescope: it wouldn't hurt even a Hiroshima flea.

Whatever the cause, the waves do have something to tell us—as immediately practical as where to spend millions of dollars on high-frequency broadcast stations, and as fundamental as the nature of the universe in which we whirl out our days. END

Molecular Action Signals Heat

HEAT depends upon molecular motion. The air of an oven feels hot to the hand because the vibrating molecules of air strike the hands swiftly.

GRASS looks green because it absorbs all the light from the sun except the green rays that it reflects to the eye.

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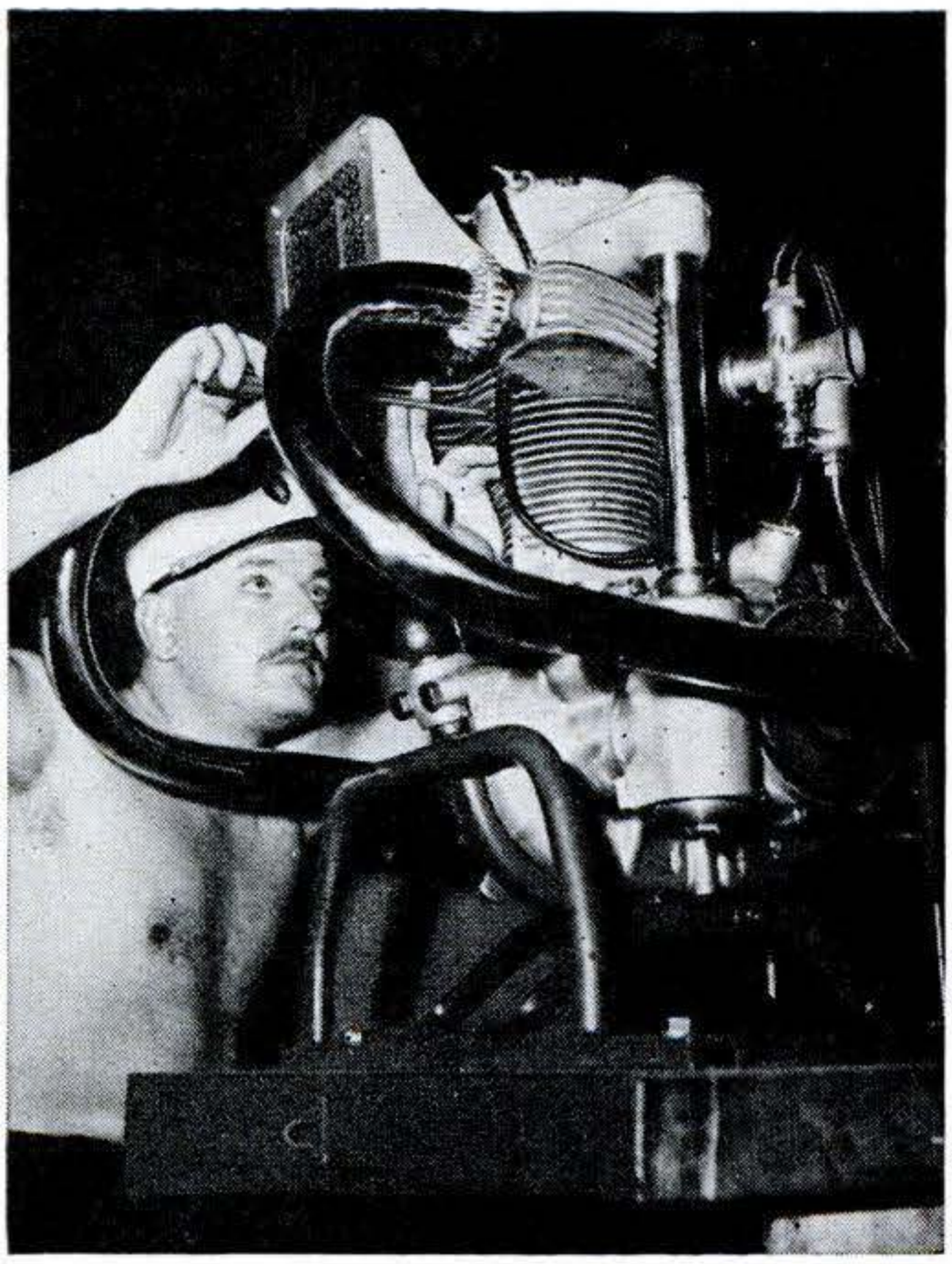
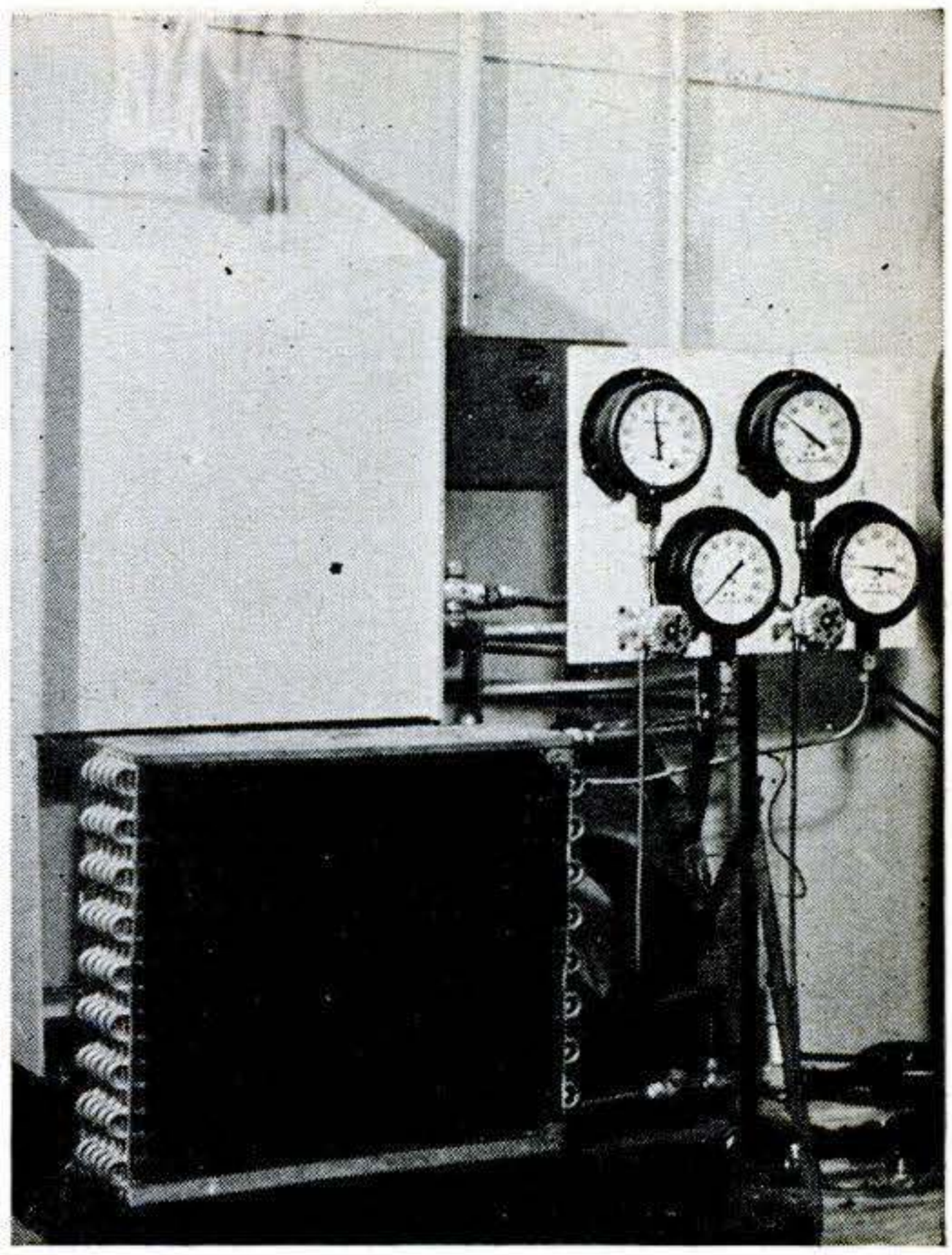


Engine Without Valves

FEWER moving parts and easy disassembly are among the advantages of this new valveless, one-cylinder, four-cycle engine, shown being demonstrated by its French Foreign Legion inventor at a recent Paris exhibition. A continuously rotating sleeve above the cylinder, turning at one-quarter speed, feeds gas directly from the carburetor into the cylinder. Replacing the usual valve and cam arrangement, this sleeve and the drive shaft are the only moving parts of the fuel-intake, distribution, and exhaust system. Only three wrenches are needed to mount or disassemble the engine, which develops 32 hp. at its maximum 8,200 r.p.m.



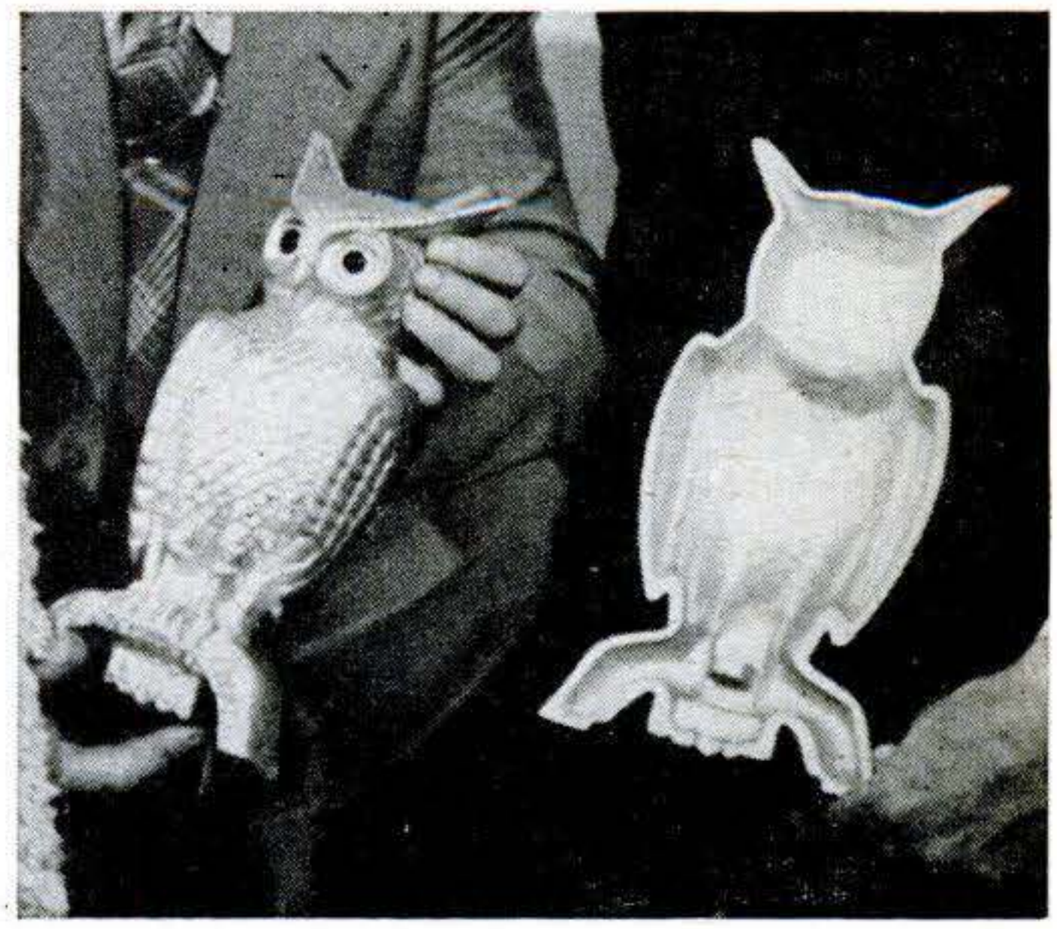
Air Used to Heat Water

THIS evaporator draws unneeded heat from a room or basement to make hot water. It works like the similar unit that draws heat from the food in your refrigerator. Freon gas in the evaporator, warmed to room temperature, is compressed by an electrically driven pump, making it really hot. This Freon next passes through coils to a storage tank, condenses, and releases its heat into the water, raising it to 150°. A series of valves then allows the Freon to expand and flow back to the evaporator for re-use. When perfected, the system is expected to be more economical and uniform in operation than ordinary water heaters.

"Owls" Oust Starlings

WEATHER-RESISTANT and doubly effective, the metal, two-faced phony at the right came to the rescue of Decatur, Ill., citizens when some million-and-a-half starlings took over the city as a roosting ground.

At first, stuffed owls, placed in treetops and on buildings, were used to scare the bird pests, but wind and rain soon knocked their stuffings out. That is when health department officials came up with the aluminum owls. The two cast halfs shown here are joined, making a double bird 14 inches high, with lifelike glaring eyes and painted to give a featherlike effect.



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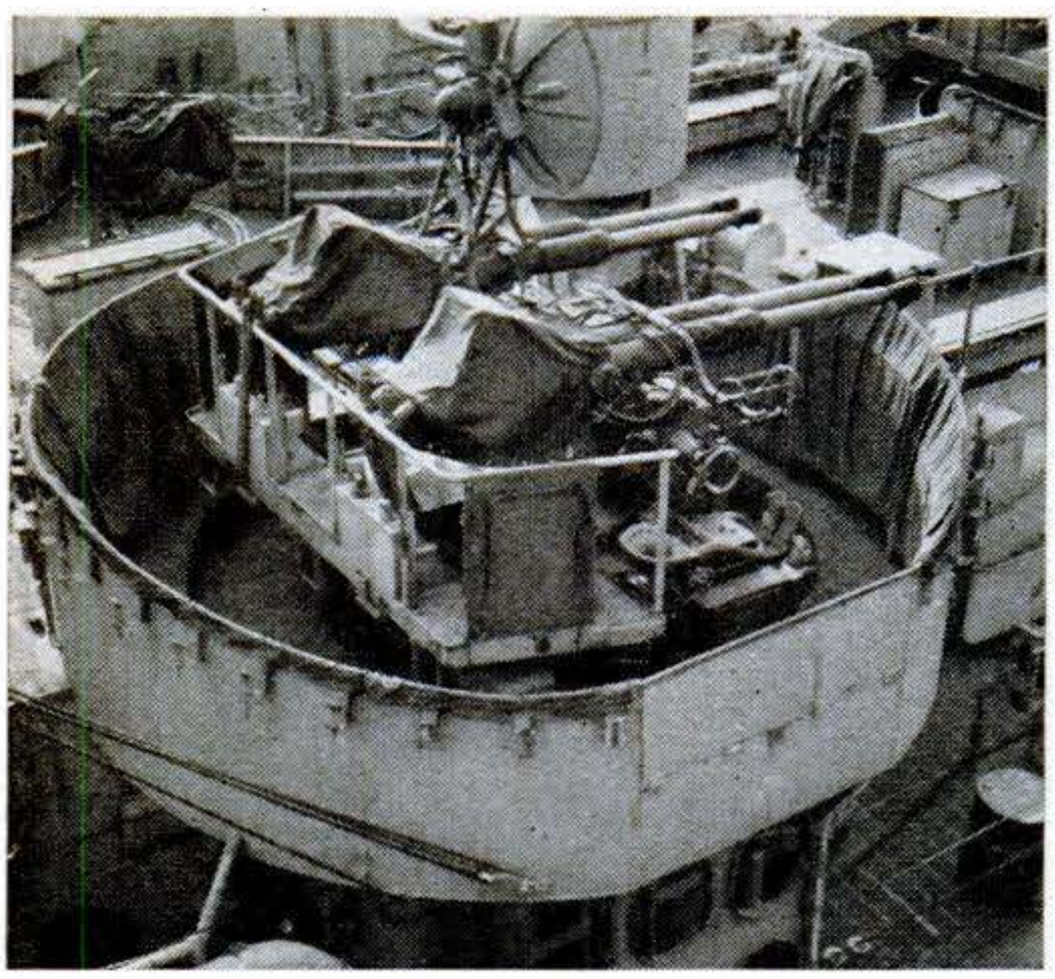
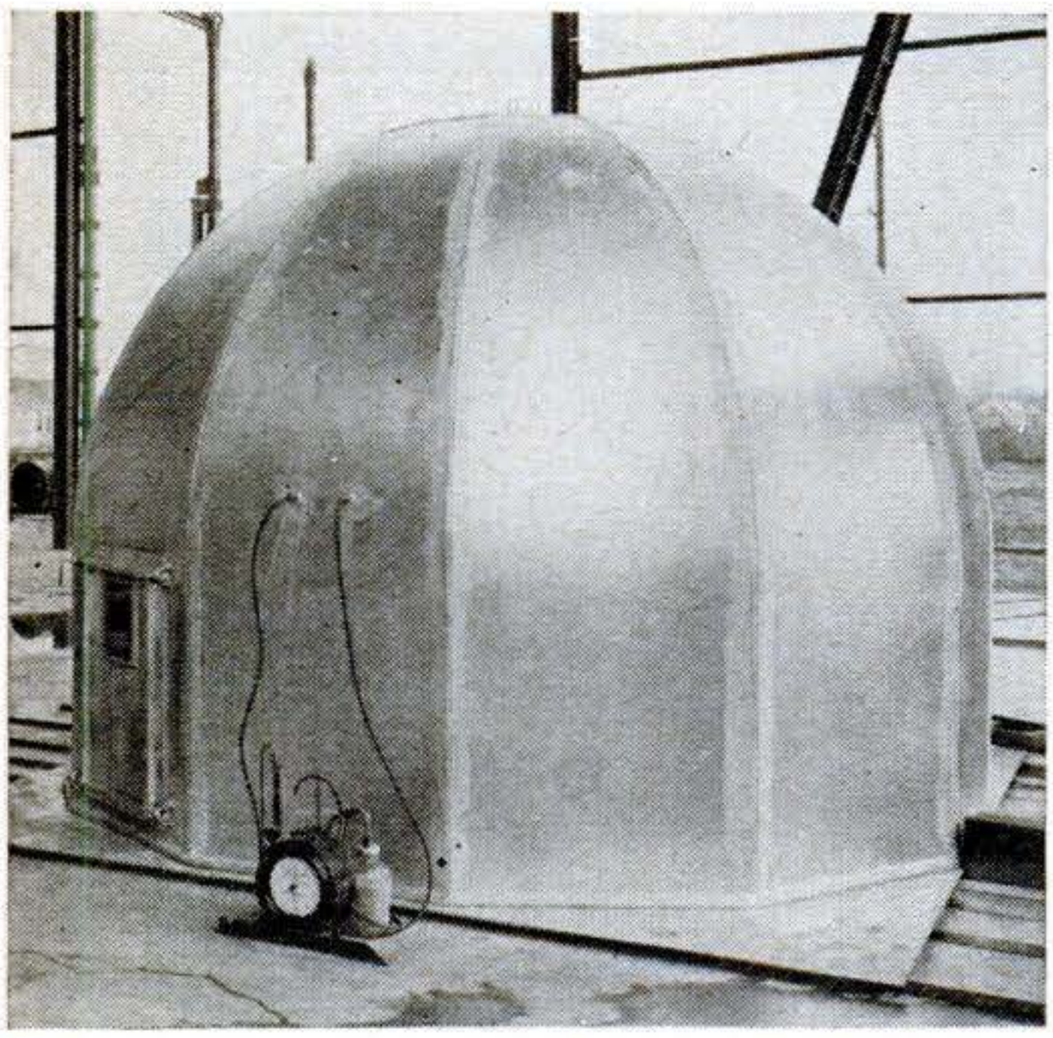
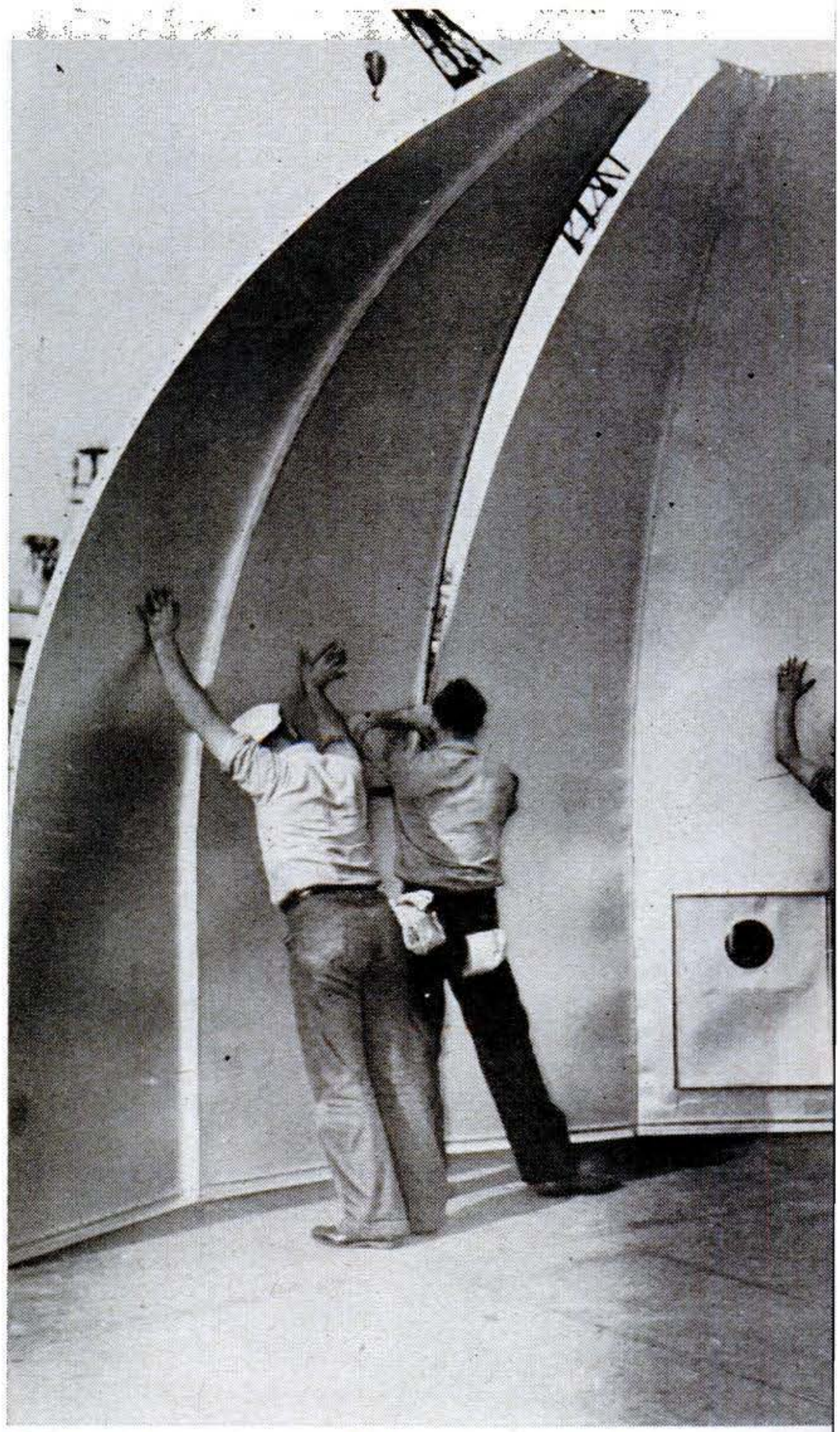


This was the problem—finding a lasting, easily installed covering to keep harmful moisture away from cluttered gun mounts like the 40-mm. "quad" shown above. Cramped quarters and uneven platforms made it quite a puzzle.



This is the answer—a sheet-steel dome, prefabricated in orange-peel sections. Test models withstood rain and hosings, supported a ton of bricks without sagging. Door, at left of test gauge, permits inspection of contents.



Two or three men can bolt sections together. Gaskets make flanged joints tight, and a special rubber seal at the foot of the panels grips even a warped deck firmly. Houses leak only a fraction as much as plastic cocoons.

How Igloos For Guns Are Built

A PREFAB housing program—for guns, not men—is changing the looks of the U. S. Navy's inactive fleet. Ragged outlines of topside armament are disappearing under shining steel igloos that will keep idle guns and firing mechanisms ready for business for the next quarter of a century.

The long-lived huts are made of preformed segments that bolt together into a 12-sided dome. They can be set up on shipboard by untrained workers, they need no maintenance, and they permit inspection

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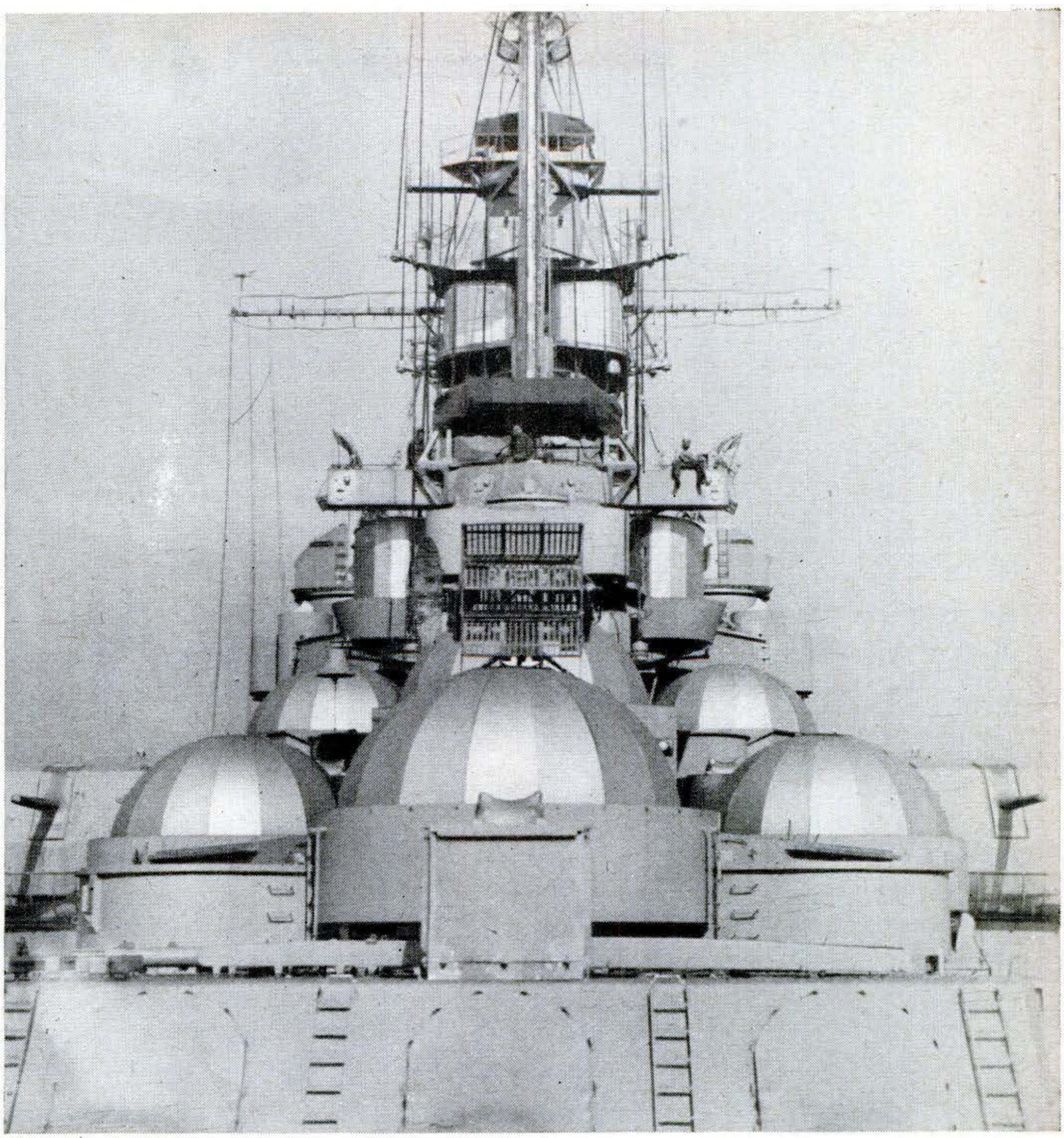

The Navy's "New Look." Gun barrels of the antiaircraft armament on the U.S.S. *South Dakota* have been dismounted and stowed inside domes. A variation of the basic metal house has an attachment like a stovepipe to fit over heavier guns whose barrels are left in place. Either way, with a dehumidifying agent keeping the interior of the houses bone-dry, guns and machinery are as thoroughly protected as the interior of the ship itself.

of their contents at any time. So they are replacing strippable plastic cocoons, which in turn replaced the greasy preservatives used after World War I (PSM, Mar. '46, p. 126). Plastic film is fussy stuff to apply, and its life is limited.

The purpose of the steel huts, of course, is the same as that of the plastic: to keep out moisture and thus protect metal parts from rust and corrosion. But Ray Hackett, an engineer with the R. C. Mahon Co., of Detroit, who designed the hut for the Navy, faced a lot of problems. The houses had to be strong enough to stand a full gale or a heavy accumulation of snow. They had to form a moisture-tight seal. They had to be light and easy to handle.

The sheet-steel dome is the answer. Its shape alone gives it sufficient strength, with no need for any interior bracing to add weight and complicate assembly. And whenever the Navy needs its ships and guns again, the neat round huts can be yanked off in a hurry. END

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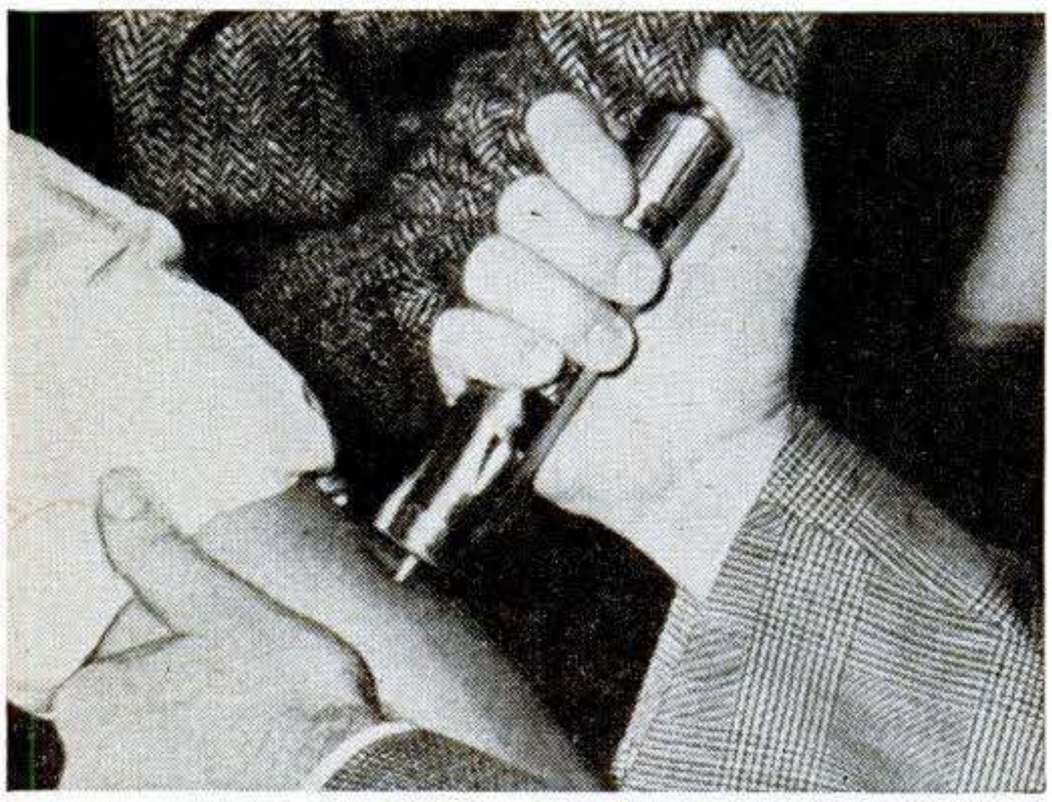
Junior at the Wheel

MANY a parent has wished for something to keep Junior occupied during long drives. With this toy steering wheel, daddy can concentrate on the road ahead while young hopeful makes believe he too is driving. Made of hard rubber, the mock wheel is attached to the dashboard by a suction cup. It even has a horn that works.

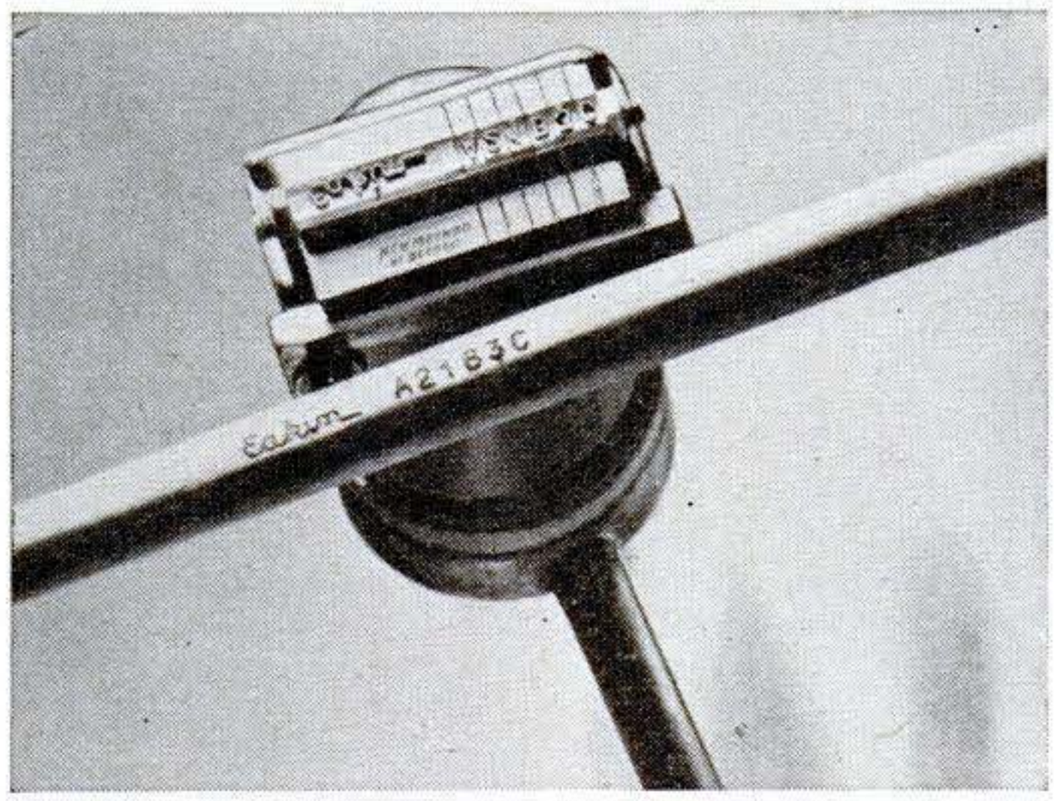
Crystal Tied in a Knot

FLEXIBILITY of an artificially grown silver-chloride crystal is demonstrated here by Dr. H. C. Kremers, of the Harshaw Chemical Co. The crystals are pressed into slabs, then rolled into thin sheets—but each sheet is still a single crystal. Because they pass radiation, the sheets are used as windows in radar apparatus and infrared devices.



Painless Puncture

A DOCTOR with needle poised need no longer be feared by his patient. The new Hypospray shown above makes the injection of medicines through the skin almost painless. Flashlight size, the "gun" is operated by compressed air. The instrument was demonstrated recently by Dr. Edward B. Tuohy, President of the American Society of Anesthesiologists, at a meeting of the District of Columbia Medical Society.



Branding Made Easy

THIS high-speed branding iron for marking wood and leather is electrically heated and can be used in presses or operated by hand. Interchangeable type, made of a bronze alloy for quick heating, is held in place by a dovetail clamp. A steel shank on the back of the heating element permits fitting the unit into a press. Made by New Method Steel Stamps, Inc., of Detroit, the brander works from any 110-volt socket.

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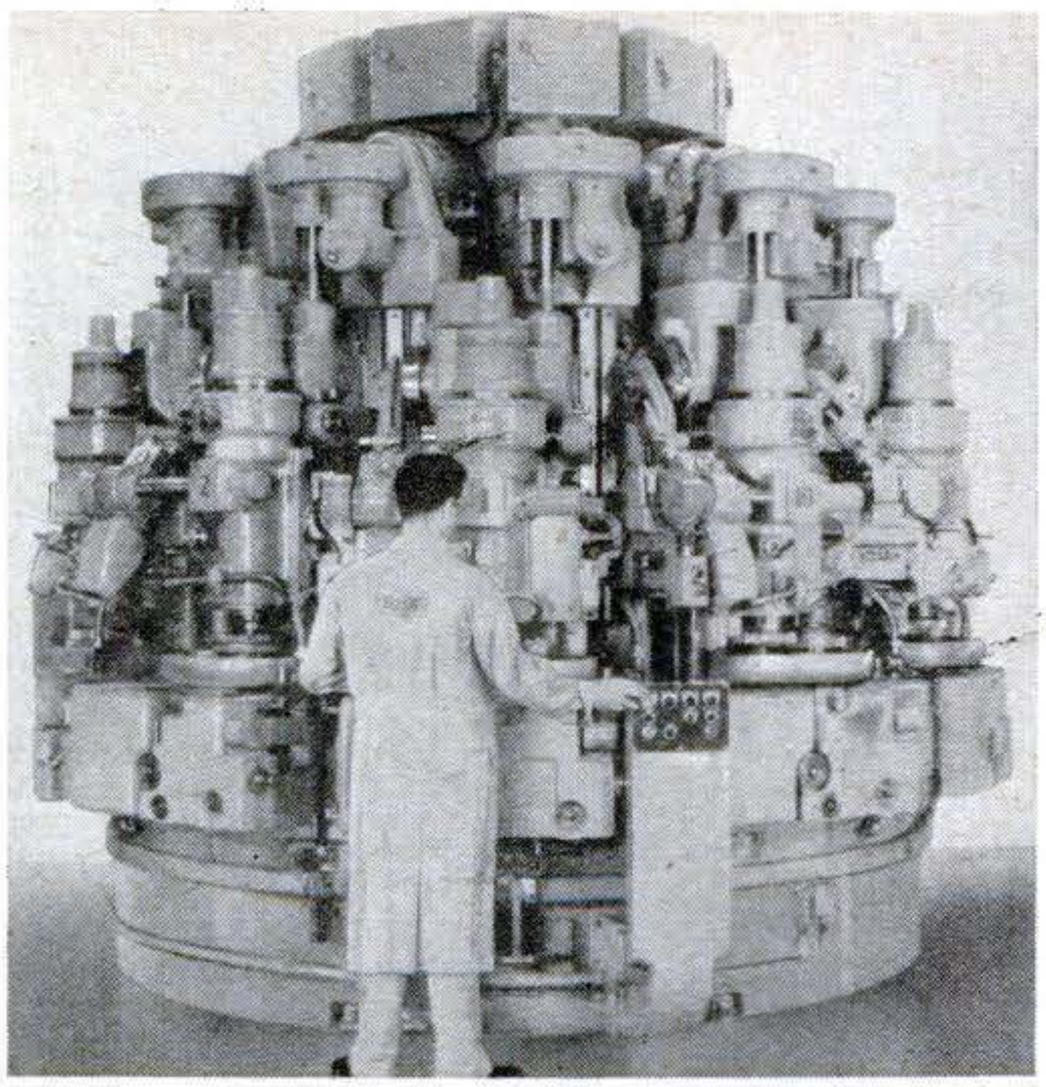


One Machine Turns Ten

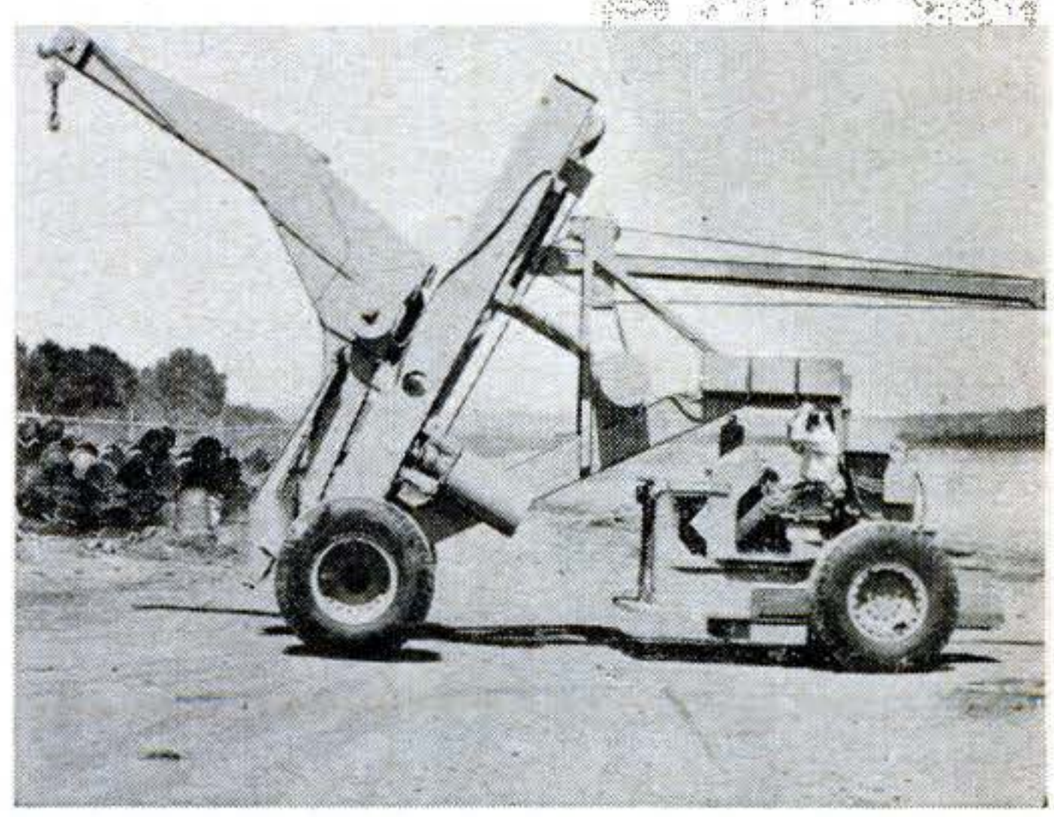
THIS giant "lazy susan" has 10 complete gear-cutting machines on one revolving turntable. One man can run it; he merely loads and unloads the machines as they go by him. It can be rotated in either direction at desired speeds, has separate controls at each tool, and disposes of chips automatically. Made by the Fellows Gear Shaper Co., it weighs 42½ tons, cost $75,000.

Camera Snaps Answers

TO SPEED recording answers in computing machines, Kodak has made a new camera that snaps 1,000 12-digit numbers a second. The numbers are photographed from a cathode-ray tube as spots; retranslated into electrical impulses by photoelectric tubes as desired for feeding back into the computer. Mosaic above is film section enlarged 25 times. A 100-foot strip holds 3,000,000 digits.

Half-Track Pulls Plow

HERE'S a half-track for small farms, golf courses, and gardens. It weighs 750 lb., has six hp., runs four hours on a gallon of gas, and can pull a 10-inch plow. Tracks distribute the engine's weight, increase traction, and prevent miring. Rear mounting of the air-cooled engine keeps heat and fumes behind the driver. It was developed by Super-Trac, Inc. to retail for less than $500.



Crash Crane Aids Planes

CARRIER-PLANE pilots can look forward to speedier rescues, thanks to a new Navy crash crane that packs nearly twice as much muscle as any of its predecessors. Entirely electric, the mobile, folding crane has a normal lifting capacity of 24,000 pounds, a vertical lift of 65 feet, and a speed of 10 m.p.h. Though larger than previous models, it requires less stowage space when folded.

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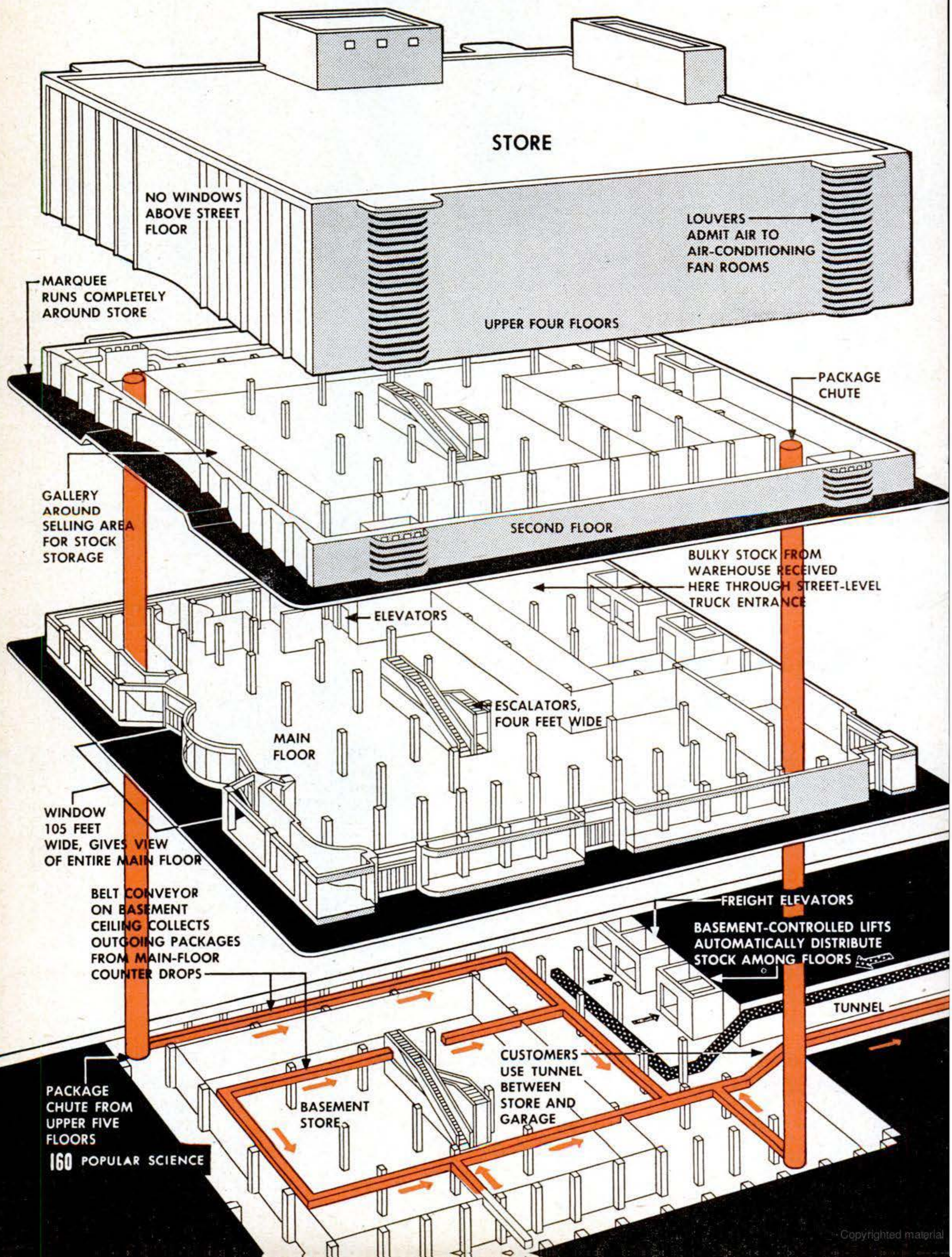
Tomorrow's Store

Foley's is designed to channel the flow of incoming stock and outgoing customers and purchases with maximum efficiency.



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Today

DOWN in Houston, Texas, is what is said to be the most modern department store in the world. Foley's is carefully planned to speed the flow of customers and merchandise. Shoppers park their cars in the garage and walk through a tunnel to the store. All purchases go down a chute to the basement and travel on a belt conveyor to the sorting ring in the garage. Each customer's bundles are waiting for him when he is ready to drive out. The ten-million-dollar store is six stories high, but it has been so built that six more stories can be added if business increases and more space is needed.

There are no windows in Foley's except for main-floor displays. Air conditioning provides ventilation; all lighting is artificial.

GARAGE

FOUR OPEN-SIDED PARKING FLOORS

RAMP FOR STORE'S TRUCKS

CUSTOMERS' CAR EXIT

CUSTOMERS PICK UP PARCELS HERE

RECEIVING PLATFORM

CHUTE

CAR LIFT

AUTO ACCESSORIES

CUSTOMERS' CAR ENTRANCE

TRUCKS DELIVER INCOMING STOCK HERE

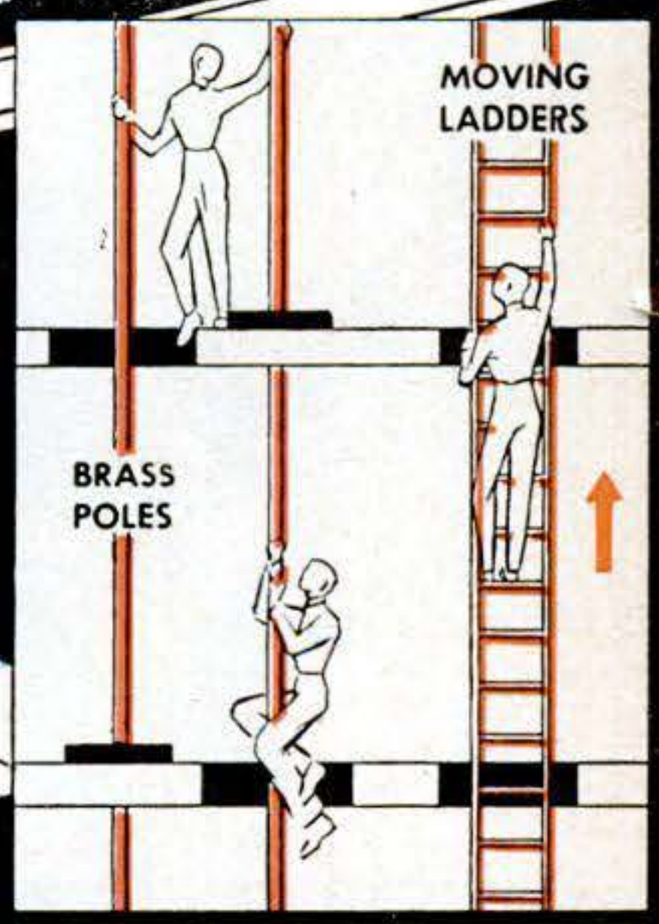
TRUCK RAMP

BELT CONVEYOR FOR INCOMING STOCK

TRUCK LOADING PLATFORM

GARAGE BASEMENT

SORTING RING WHERE OUTGOING MERCHANDISE IS SORTED INTO THREE CLASSES; CUSTOMER PARCELS (PICK-UP IN GARAGE UPSTAIRS), MAILING, AND GENERAL DELIVERY



The boys who park your car on upper floors of garage slide down again on brass poles like firemen. When they go up after cars, boys are lifted on moving ladders.

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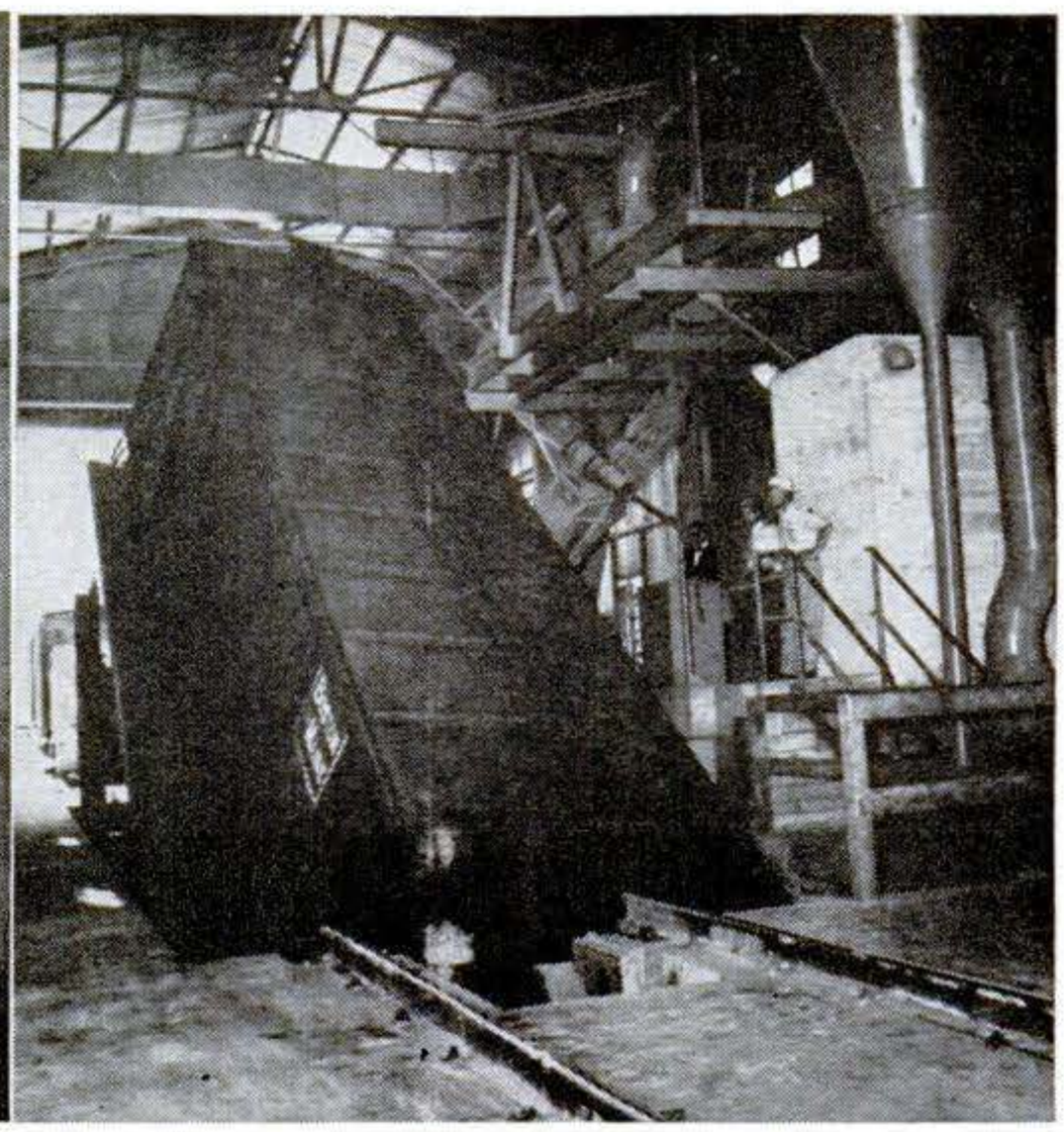
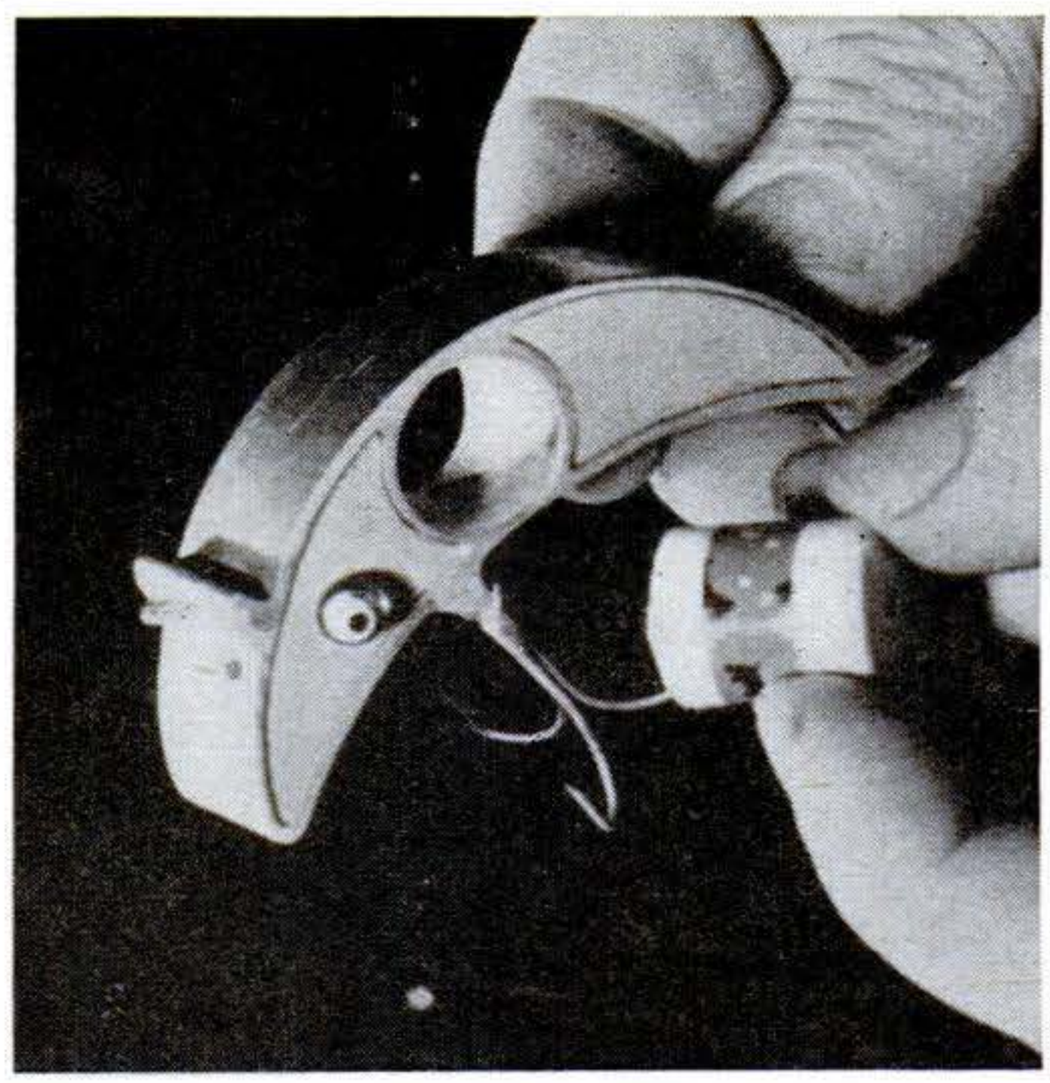


Dumps Grain Car Faster

THIS new mechanical unloader shakes a freight car like a box of cornflakes, dumping its load of grain in one-tenth the time hand shovels would take. As operator throws a switch, a mechanical arm (left, above) opens the side door, tilts the car sideways, and starts flow of grain. Another control tips the car endways (right, above), cascading grain into pits under the tracks. Next the car is tilted in the other direction, then leveled while men with brooms clean out what's left. The job takes six minutes.

Corridor Traffic Light

WARTIME'S proximity fuse is regulating hallway traffic at General Electric's Schenectady research laboratory. Above, the girl at left has been "picked up" by a microwave transmitting-receiving unit (A), operating traffic light (B). The girl at right, carrying delicate instruments, is warned by a red light that the corridor is not clear.



Realism Fools Fish

THERE'S a lot of life in the little capsule at the right, about to be inserted in the hollowed center of the three-inch magnesium "minnow." When the lure hits water, its contents, sodium bicarbonate and fruit acid, react to produce a stream of bubbles and a series of "pops." Alluring to fish, claims its inventor, a Westinghouse engineer.

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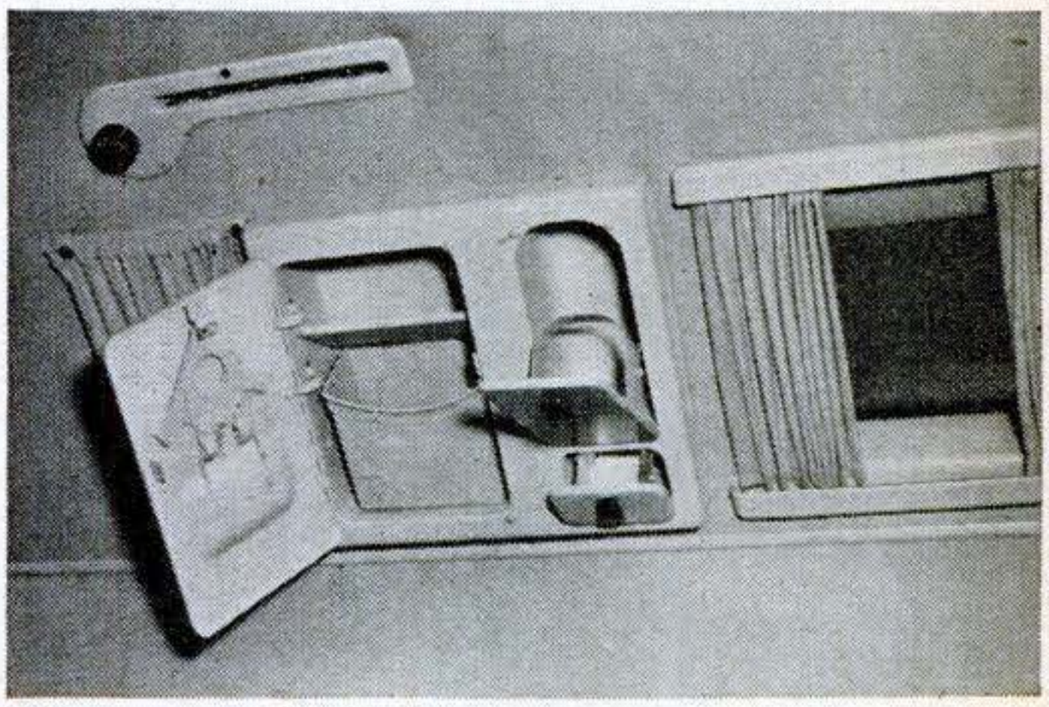
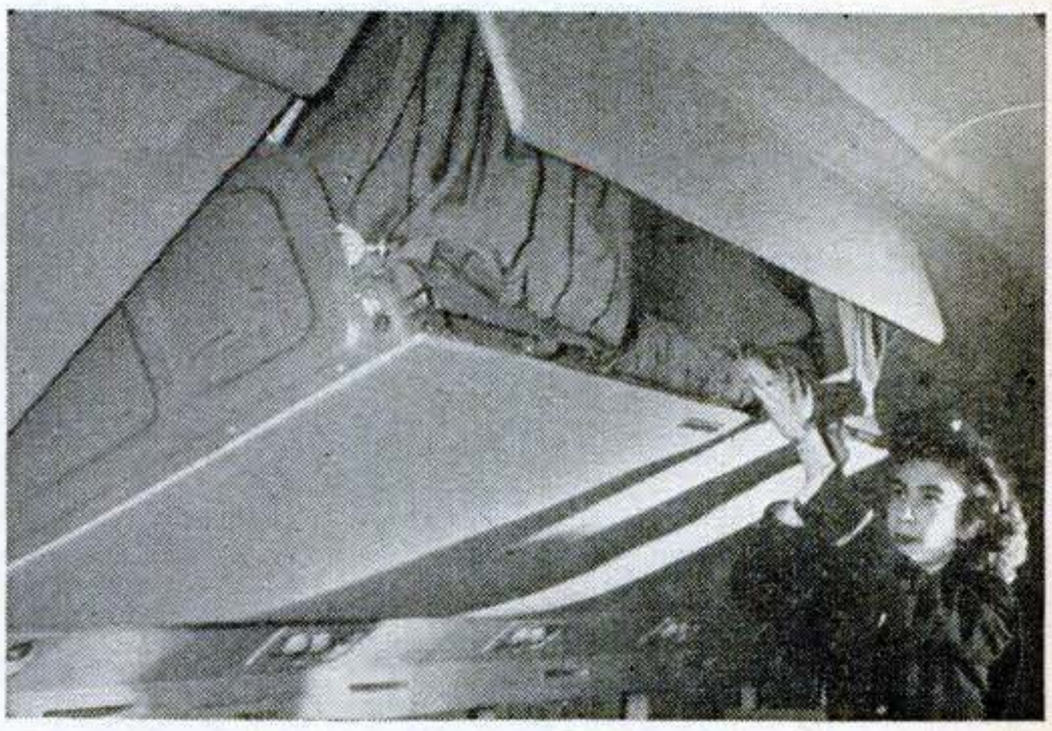
Hitting the Hay Aloft

FOR the first time in seven years, you can climb aboard a Europe-bound air liner and climb into bed. Though still scarce, sleeper planes are back, better than ever. Here's the inside of a Sabena DC-6 sleeper.

Track-mounted seats slide forward as their backs fold back flat to form lower berth. Seat belts are let out at night to become berth belts.



The upper berth boasts its own window, compartments for personal items, and separate air conditioner. A collapsible rack holds clothing.



Comes the dawn, upper berth folds neatly into ceiling. When lowered, it is supported by an aluminum rod, aided by a tensioned shock cord.

Despite necessary space economy, lower berth can sleep two, is wider and longer than its Pullman counterpart. Smaller, the upper sleeps one.

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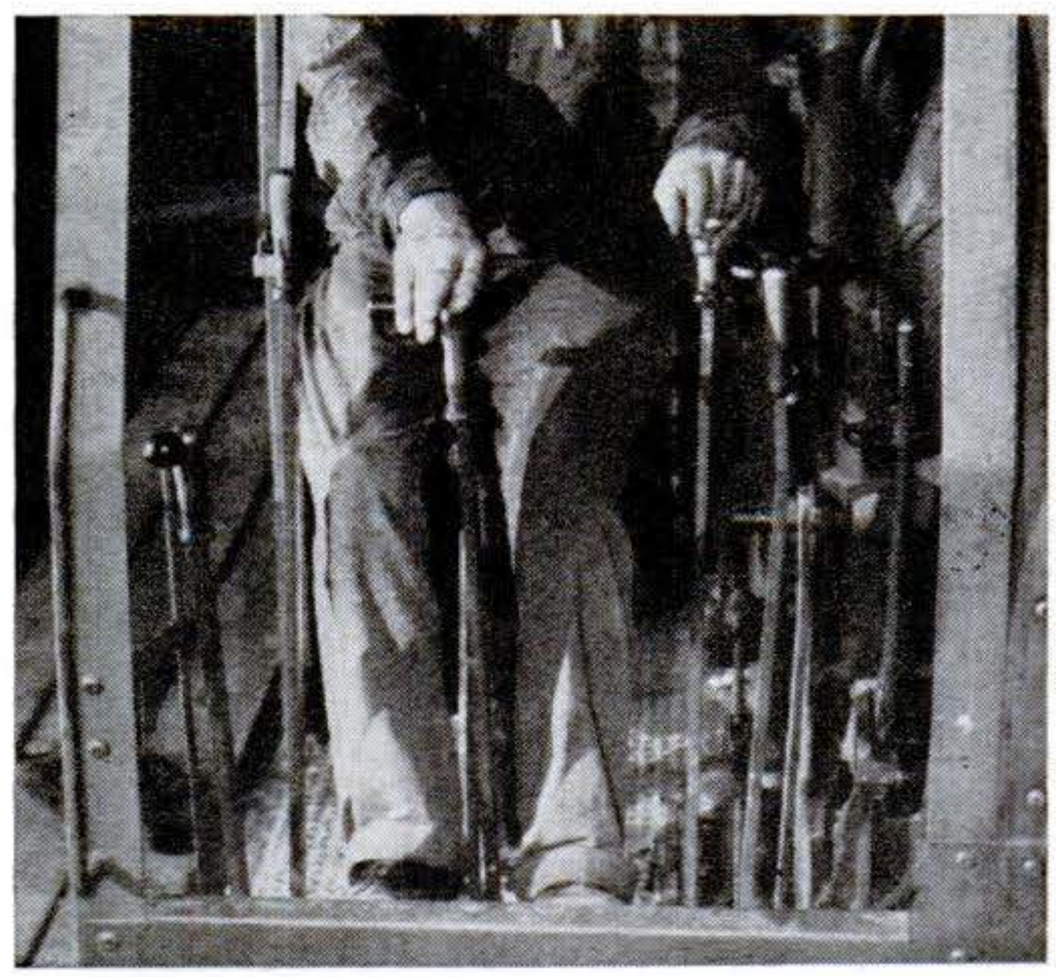
How to Run a Power Shovel

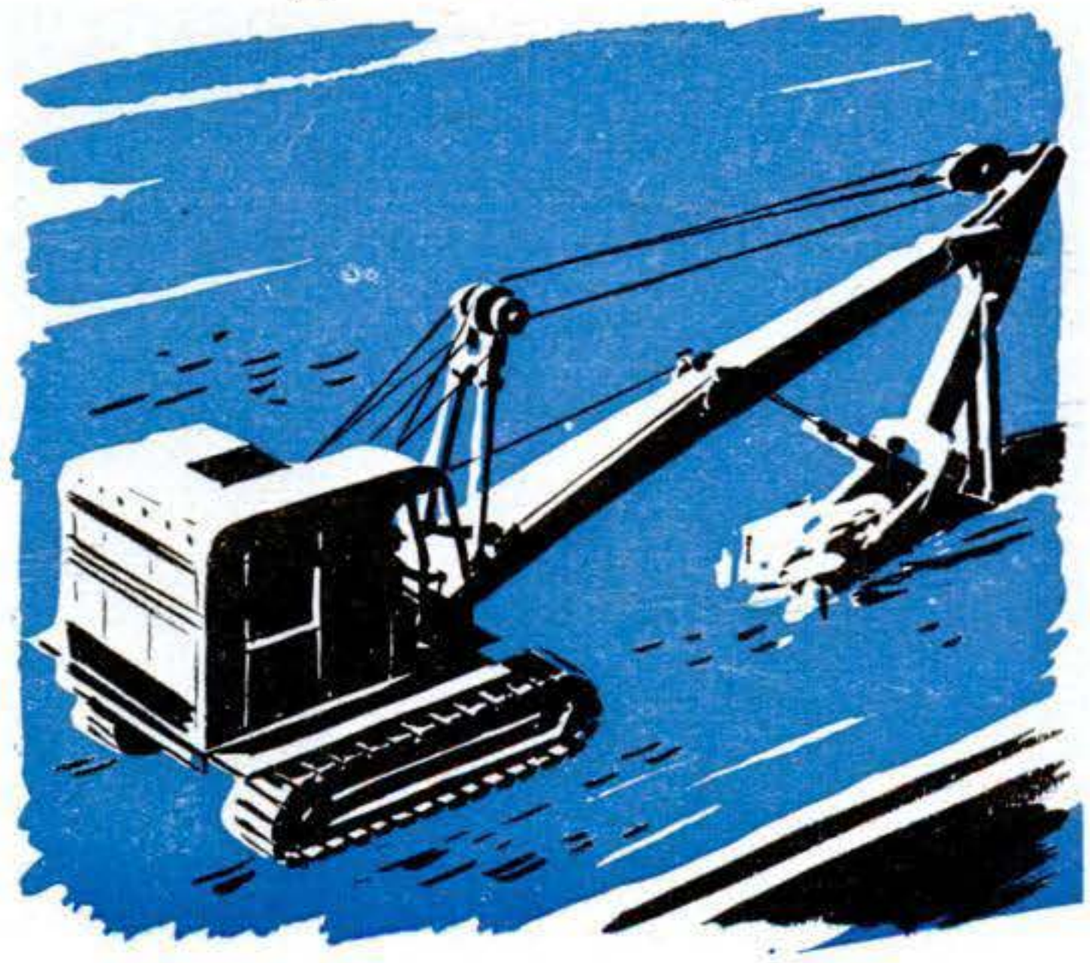
By Devon Francis

PSM photos by Hubert Luckett

1. Lock for boom and bucket foot brakes.
2. Engine clutch.
3. Hoist lever raises and lowers boom.
4. Trip for trap-release type of bucket.
5. Haul-line lever drags in bucket arm.
6. Boom-swing lever turns cab and boom.
7. Steering lever steers entire shovel.
8. Lock to keep boom from swinging.
9. Independent boom hoist.



At start of scooping phase, operator releases engine clutch and shoves forward on haul-line lever. This pulls the bucket inward toward the cab, filling it with earth from the excavation. Control movements are so complicated they often overlap, must be delicately co-ordinated.



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THE operator of a power shovel is the concert pianist of modern construction mechanics. His touch on his controls must be delicate but positive. To watch him work is an adventure into the art of controlled motion. His shovel can rip up pavement, yet one of its tines can flick a piece of dirt off the edge of an excavation as deftly as a man could with his hand.

No less than 15 controls are at the command of the hands and feet of the operator. These pictures show Louden Day, a shovel operator for 25 years, digging a ditch for the Ufheil Construction Company, of New Milford, N. J., with a ¾-yard shovel built by the Bucyrus-Erie Company, of South Milwaukee, Wis.

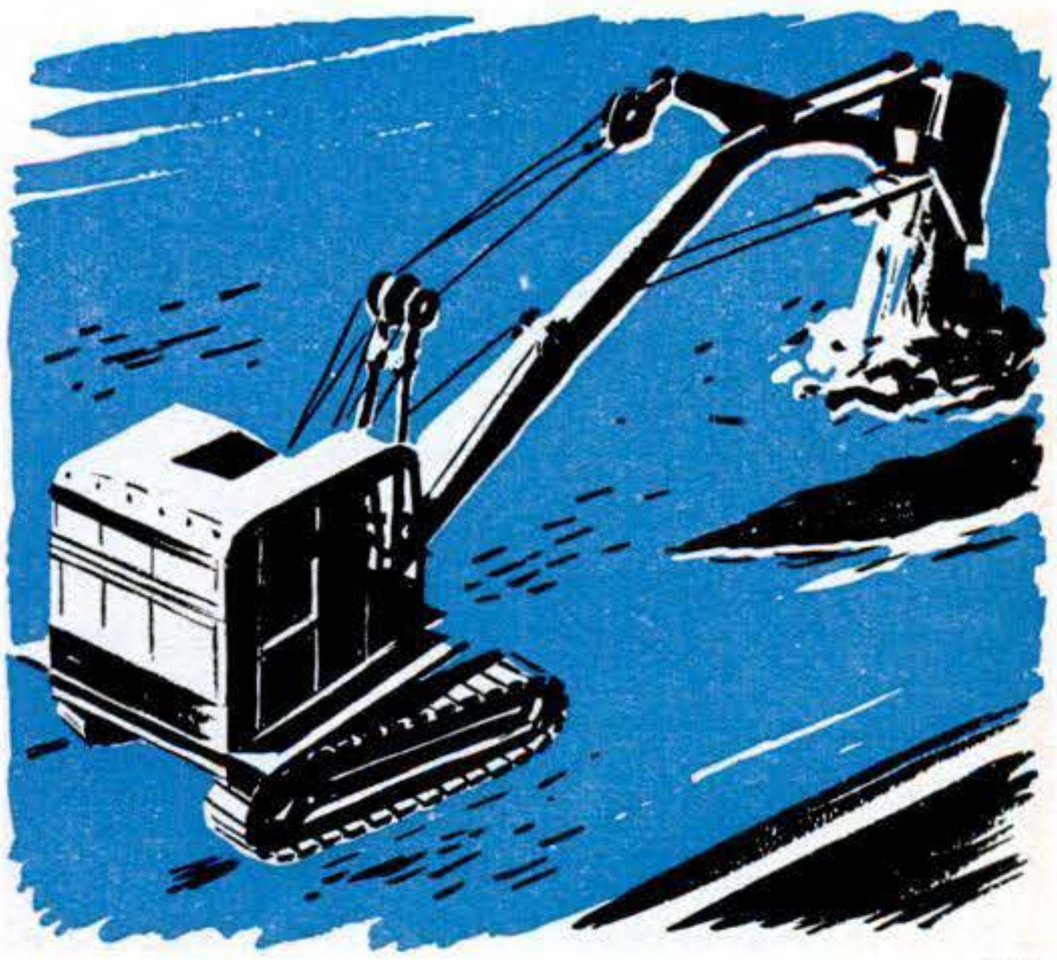
Day is just plain in love with his shovel. He'll talk your arm off about it if you let him. When these pictures were taken, the bucket was being used as a drag to dig a ditch for a storm sewer.

There are lots of tricks to shovel operation. One of them is to use the back face of the bucket to level off the pile of dirt from an excavation with the same motion that is used to dump the bucket. This keeps the dirt from piling up and toppling back into the excavation.

Shovels are versatile. They can be fitted with several kinds of booms for various jobs. With a crane boom, for instance, they can be used to set steel. The one shown here can dig down 18 to 20 feet below the surface of the ground, using the back hoe, and can be dumped at heights up to 14 feet.

As loaded bucket swings back, operator brings foot down on right pedal to hold bucket in raised position while also pushing forward on hoist lever to lift boom. Bucket is then swung over dump pile by boom-swing lever, moved forward in this case to turn the entire cab to the left.

To complete dumping operation, the right foot pedal is released, permitting gravity to swing bucket outward. At top of swing, pedal is again depressed, holding bucket upside down to spill out dirt. Boom, with bucket extended, swings back to excavation, and the cycle begins again.



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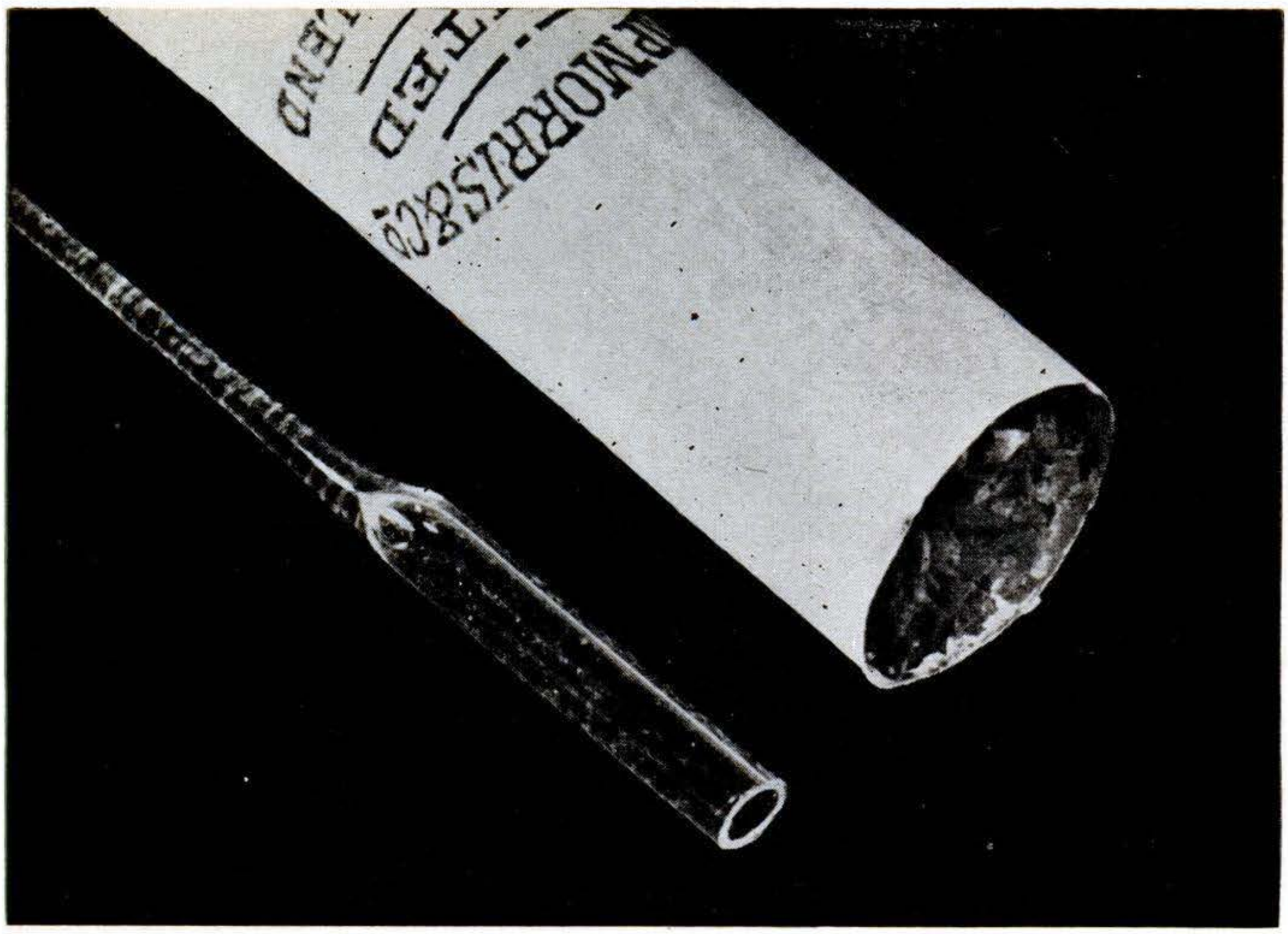

Test tubes like the one above, smaller than cigarette tip, hold solutions for microchemists.

They Can Analyze the Cinder in Your Eye

That's a lot to the microchemists, who help atomic scientists, medics, historians, and sportsmen.

PSM photos by Robert F. Smith

WHEN archaeologists pulled an ancient Roman emperor's yacht out of an Italian lake bed, they found it decorated with a breath-taking variety of glass mosaics, indicating that every glassmaker in the old empire must have contributed to the job. But a microchemist, accustomed to working with fantastically small quantities, found traces of the same substance in each type. The archaeologists were wrong. All the different kinds had come from a single factory.

Checking the ancestry of 2,000-year-old glass may seem a strange assignment for a chemist, but not for a microchemist. He gets a lot of queer jobs.

When a good horse runs a suspiciously poor race, the N. Y. State Racing Commission sets microchemists looking for "dope." Minute amounts of drugs that would pass unnoticed in an ordinary chemical analysis are caught red-handed in a microanalysis.

A supposedly valuable old painting may actually be a modern forgery. Chemical analysis of the pigments would prove its age, but removal of more than a speck from the painting would ruin it. A speck is enough for the microchemist.

Blood tests are routine procedure in medicine. But drawing a normal sample of blood from a three-pound premature infant might kill him. The microchemist runs an analysis on *one drop* of the baby's blood.

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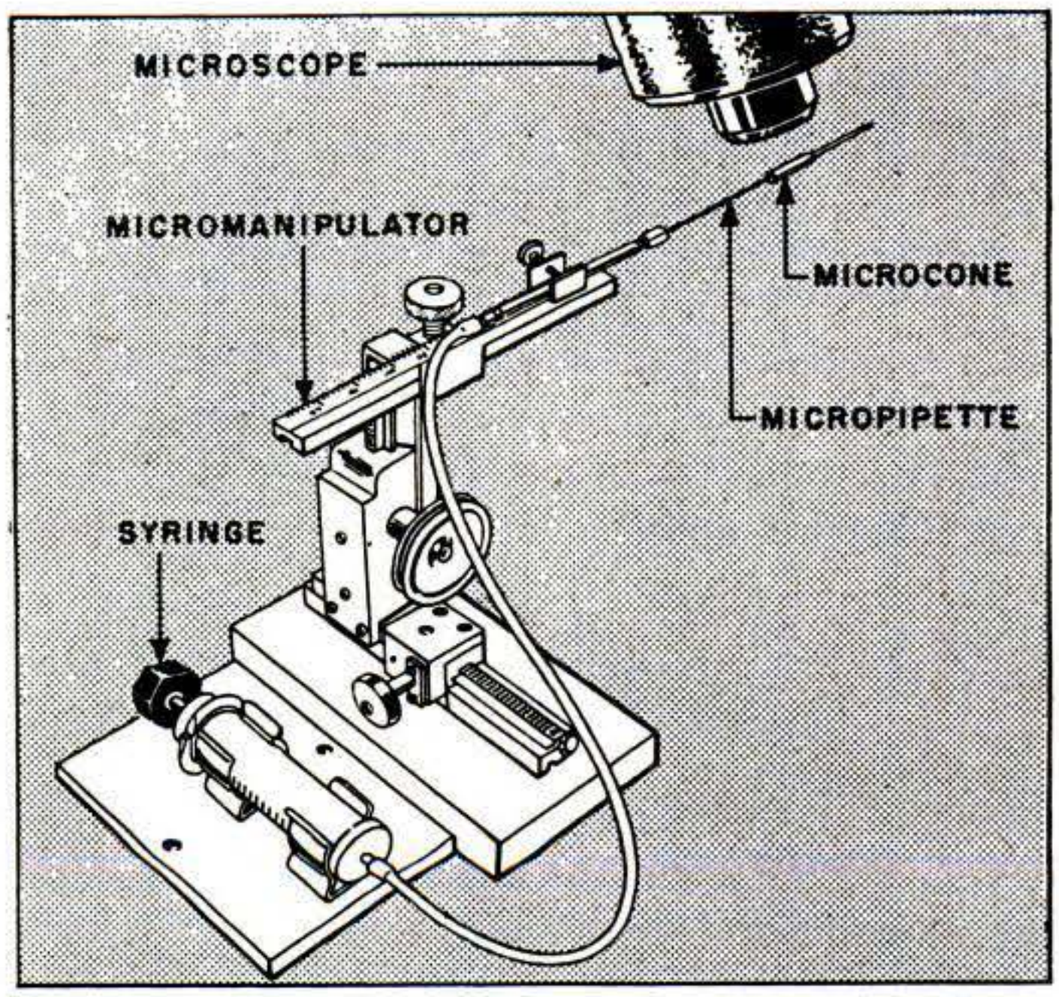
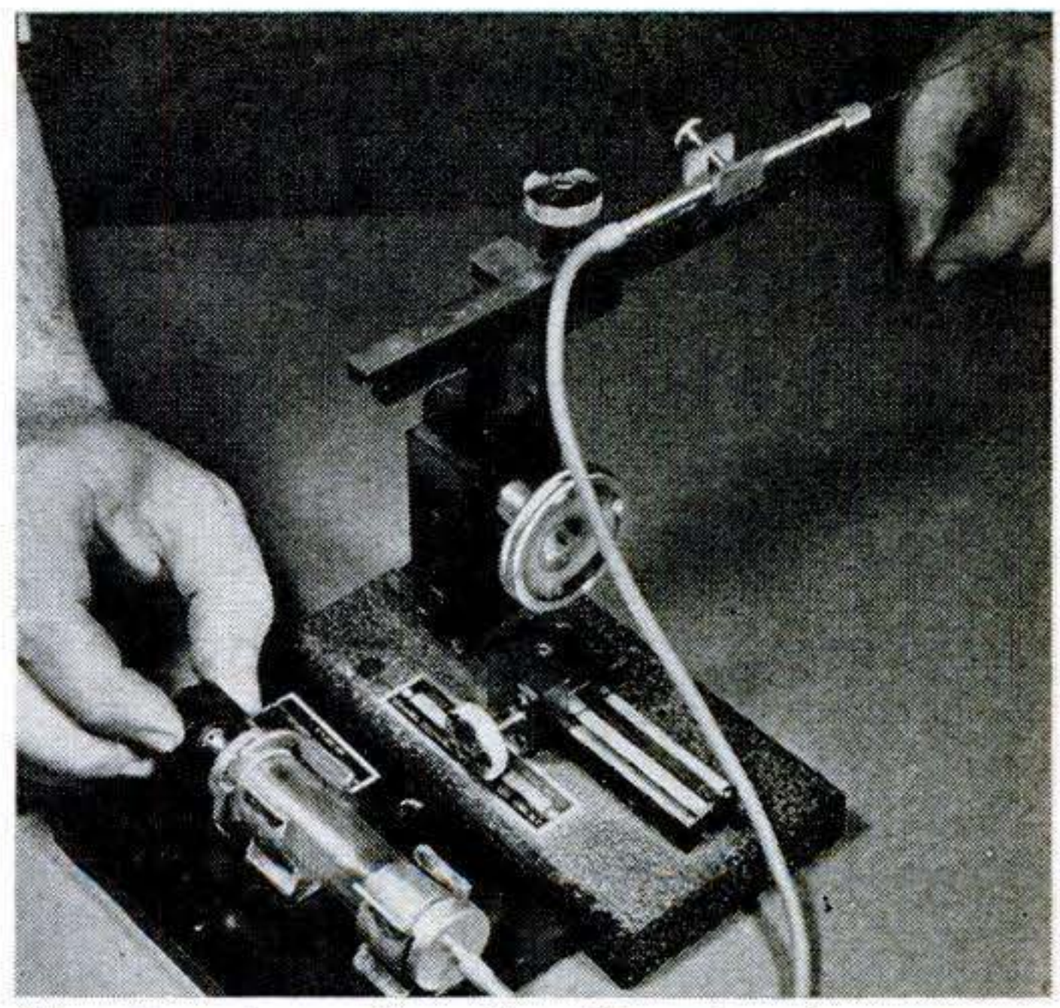
Table-top chemistry. That's practically a complete microchemical laboratory in front of Dr. Michael Cefola, Socony-Vacuum Oil Co. scientist. He performs most experiments by remote control, seldom touching the equipment, and watches what happens through the microscope.



Chemicals are added to the small test tube, called a capillary or microcone, from the tip of the micropipette. It is operated through a syringe and moved by the micromanipulator.



Turning the syringe handle raises the pressure in the rubber tube and forces liquid from the micropipette. Solutions are sucked out of microcones by turning the handle the other way.

Plutonium, the synthetic element, seemed to offer a good atomic explosive, but nothing was known about its chemistry. In fact, no one had ever even seen any! Heroic labor with cyclotrons produced a total stockpile of a few hundred micrograms of plutonium (one microgram is about 1/30,000,000 of an ounce, or 2.5 million times lighter than a dime). Yet that was enough for B. B. Cunningham, of the University of

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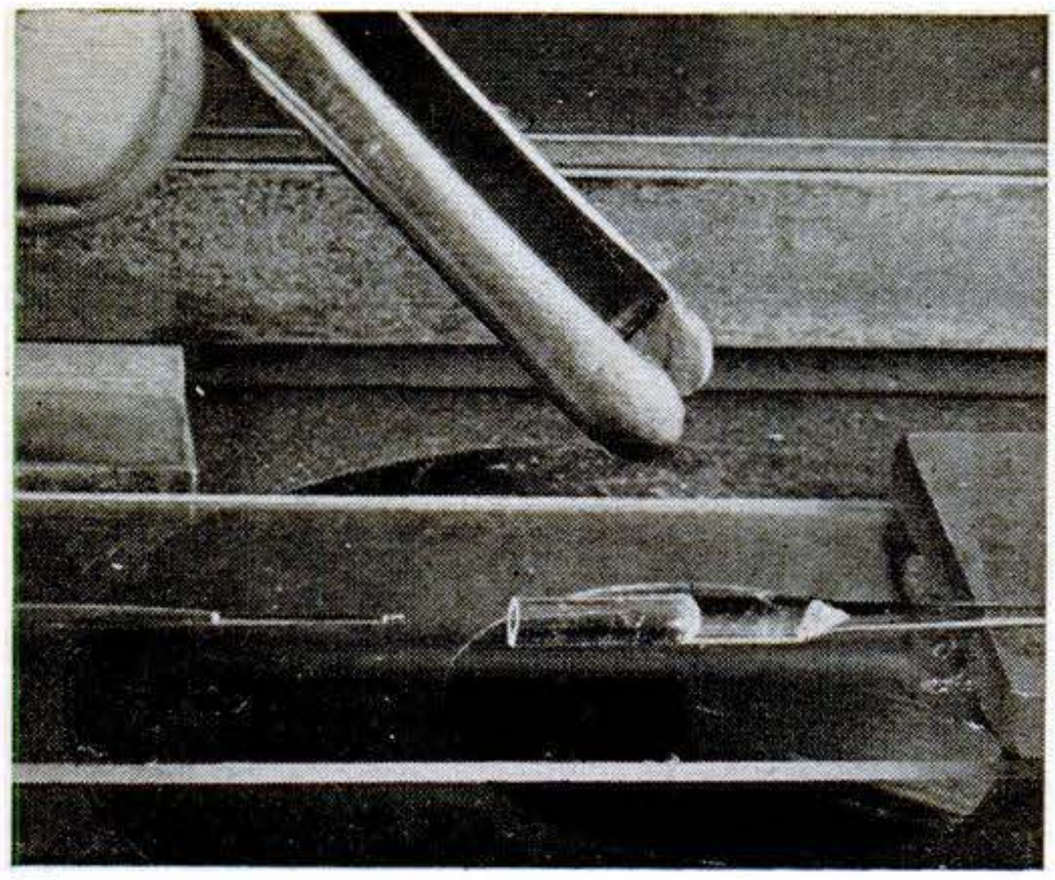
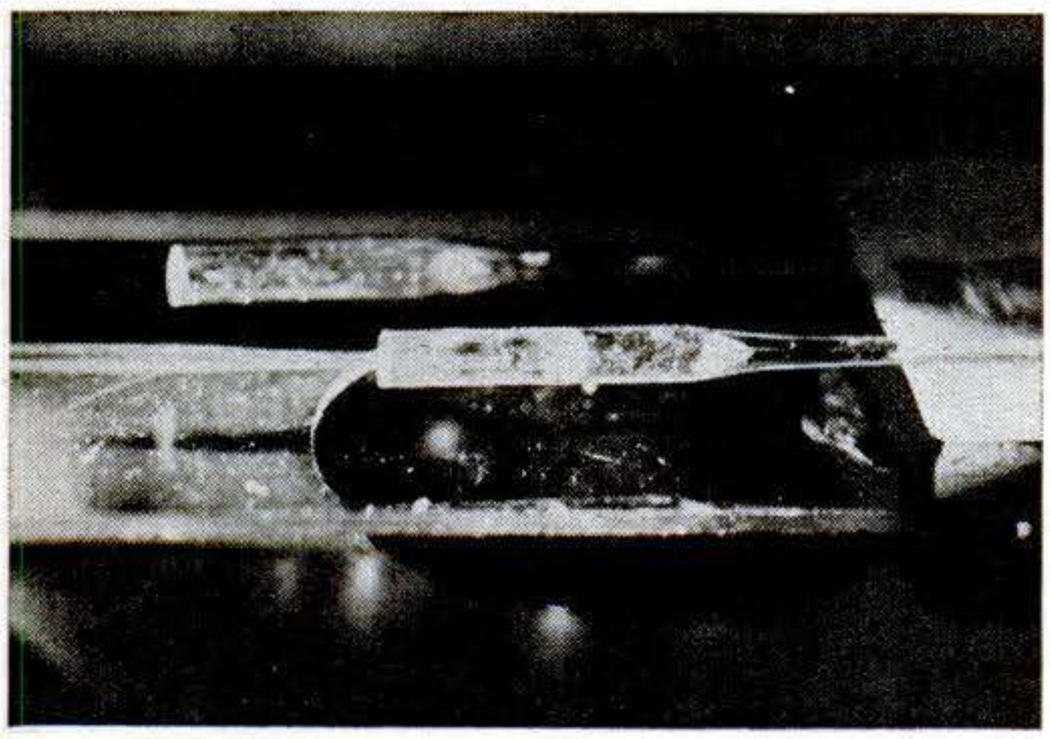
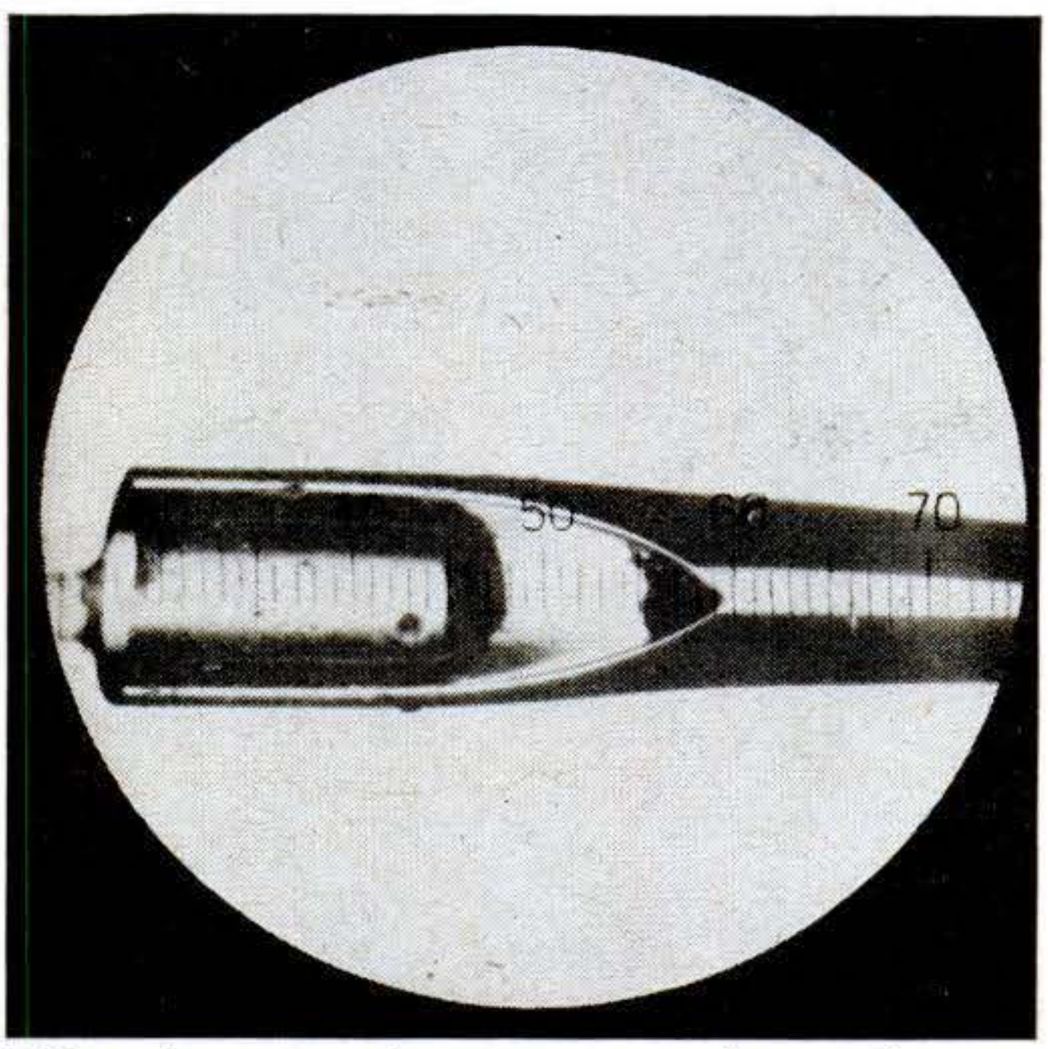


The action in microchemistry takes place on a microscope stage. Tweezers set the microcone on a glass slide, which has been covered with a light grease to hold the cone in place.



The pipette tip is inserted in the cone by adjusting the micromanipulator. If the cone is to be shifted, the entire stage of the microscope is moved with a second set of controls.



What the microchemist sees is shown above in a photomicrograph. The numbers superimposed on picture are a scale in microscope eyepiece that measures how much solution is in cone.

Chicago, and his associates to develop the process for purifying plutonium—the same process that was later used in the gigantic Hanford, Wash., plant, which handled *10 billion times* as much material!

Weighing things 2.5 million times lighter than a dime seems impossible, but the microchemists do it every day. The scale used in the plutonium project has a thin quartz fiber, fastened at one end and free to move at the other end—something like a fishing pole. The weighing pan hangs from the free end of the "pole," and the amount it bends indicates weight.

Microchemistry uses the same methods as ordinary chemistry; only the tools are different. Operations on a few micrograms must be done in very fine glass tubes held under a microscope. These tubes, called capillaries, are custom-made from ordinary glass tubing, heated and stretched like taffy until it becomes much thinner and narrower. This process is repeated until a capillary of the right size is left; some may have a bore as small as *two-thousandths* of an inch. One end, heated until it closes up, is drawn out to form a handle.

Filling these Lilliputian containers with chemical solutions requires a fancy kind of eye dropper called a micropipette. It consists of an extremely fine tapered glass tube (the opening at the tip is only 4/100,000 inch across) connected by rubber tubing to a hypodermic syringe. The syringe and tubing hold water; the glass tube, a chemical solution. An air bubble separates water from chemical. Working the syringe handle changes hydraulic pressure to force liquid in or out of the pipette.

Equipment of this kind is far too small to be moved with the fingers. The capillary containers are picked up with tweezers and laid on their sides on a microscope slide that has been coated with light grease to hold them in place. The micropipette is held in a mechanical hand called a micromanipulator. By turning gears on the micromanipulator, the micropipette tip can be moved up and down and back and forth, picking up solution from one container and putting it in another. All action takes place on the stage of a microscope so that the microchemist can see what is happening.

This testing method is so delicate that Drs. A. A. Benedetti-Pichler and Julian R. Rachele have found it capable of detecting less than a millionth of a billionth of an ounce of the element barium. **END**

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Motorcycle Cops Show How to Ride 'Em

By Tom Cameron

IF YOU'RE learning to ride a motorcycle, the policemen who patrol your streets and highways could give you some valuable pointers. Chances are these men are just about the best riders in the community. Because of the nature of their work they have to be. And it's likely this ability was not won through trial and error, for many police departments give their men a course in riding before sending them out.

One that has won acclaim for the thoroughness and success of its motorcycle training program is the Los Angeles Police Department. Out of many years of experience, embracing use of machines from the old one-lungers to the four-cylinder speedsters of today, the instructors there have evolved detailed "do" and "don't" procedures. The "don'ts" come first:

Don't be a throttle hound. This is the designation for one of those chaps who opens and closes the throttle in quick sequence to create the window-rattling bursts of sound that irritate the rest of us. Such a practice

DON'T

Never let in the clutch suddenly. If you do, the motorcycle will leap forward, unseating you.

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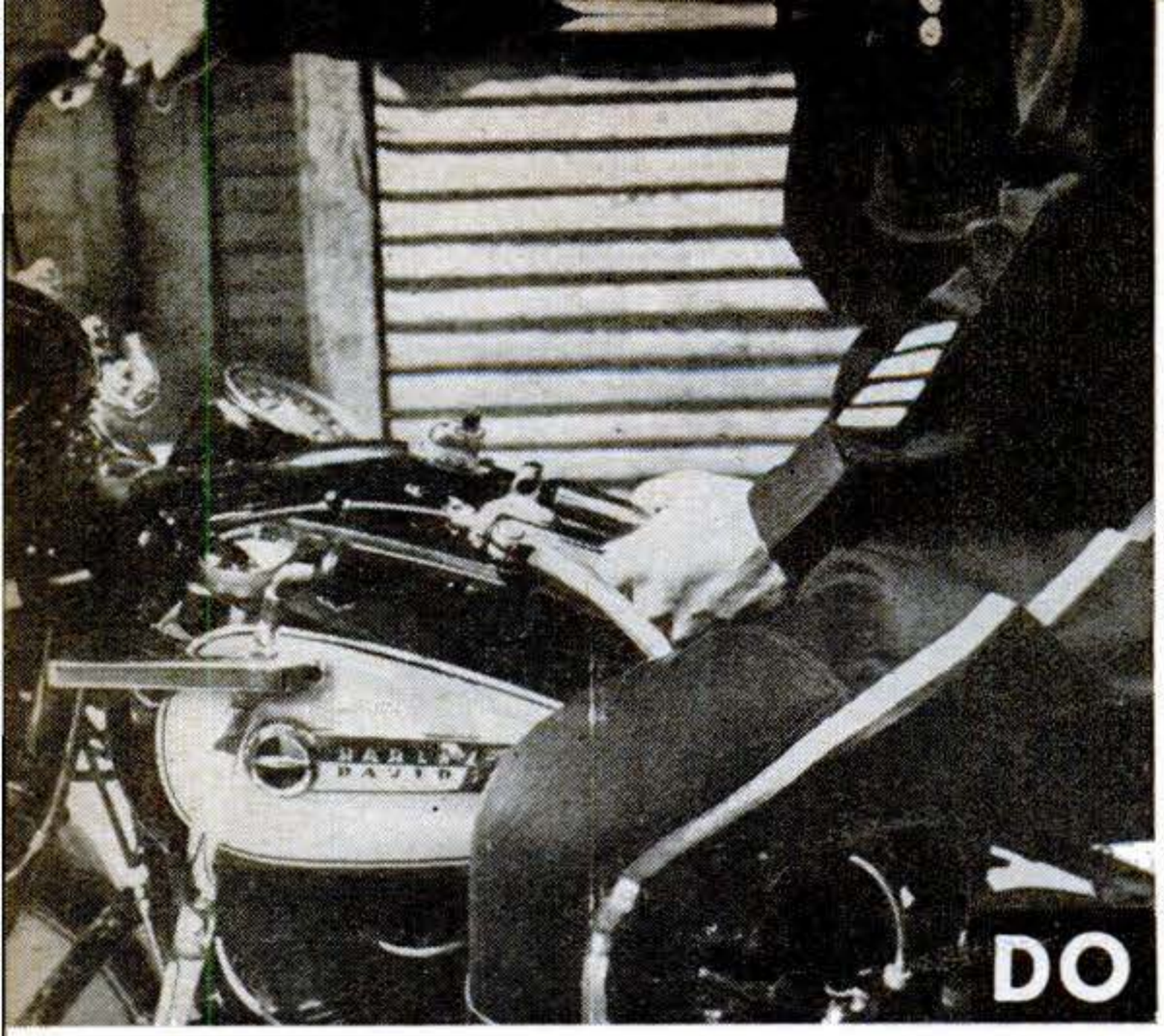
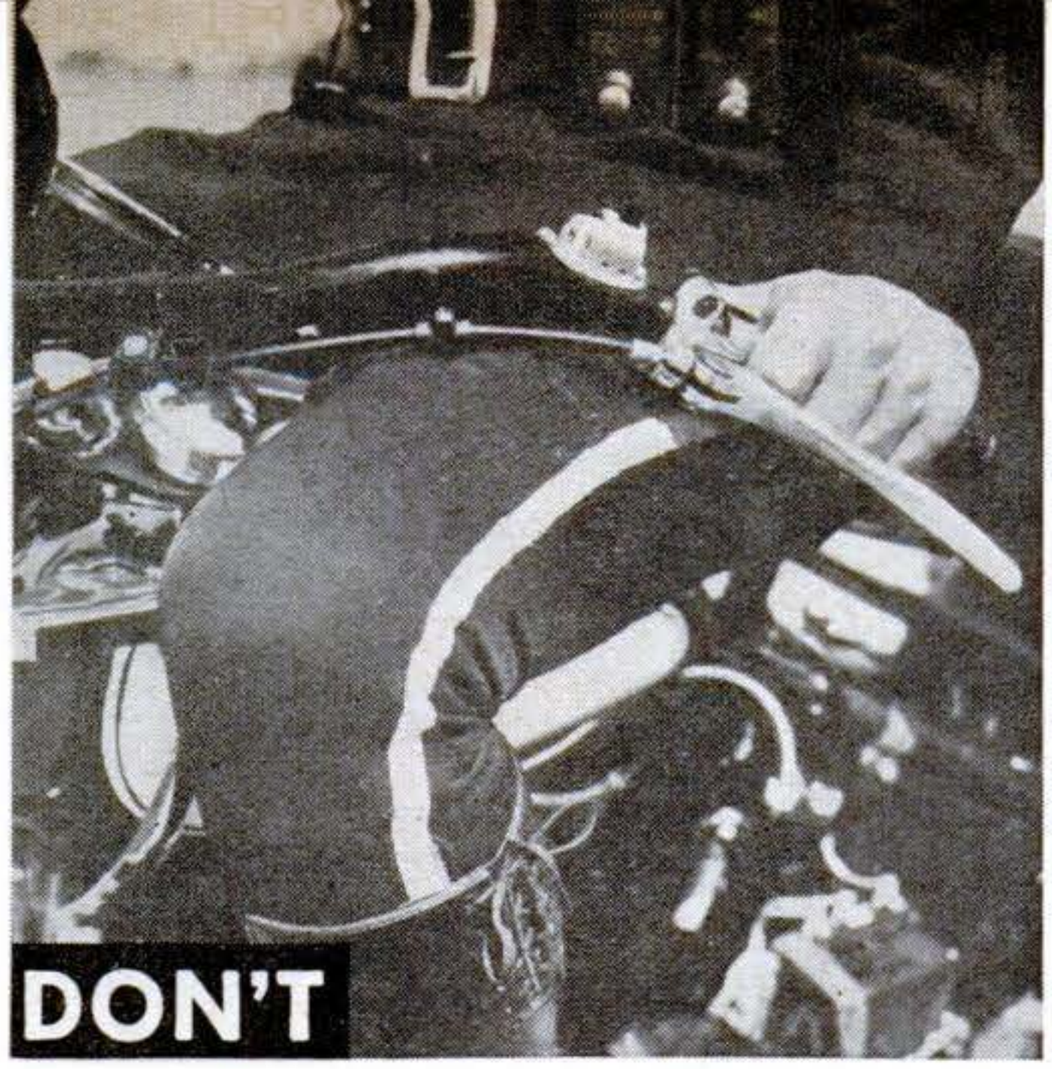


Swing out your knee, allowing the handlebar to turn when you must cut sharply to one side.



Never lock yourself in by sitting forward on a single seat in this way to carry a passenger.

is hard on the motor, causes backfires, and damages the valves, wristpins, rings, and the bearings.

Don't forget to put the sidestand in retracted position before starting the engine. The stand has a knuckle that keeps it extended. If you try to make a left turn with the stand sticking out, you may be dumped.

Don't let in the clutch suddenly. If you do, and open the throttle at the same time, your steed may unseat you.

Don't try to turn left with your left knee inside the handlebar. This locks you in. You might not be able to disengage the clutch, and you may lose control.

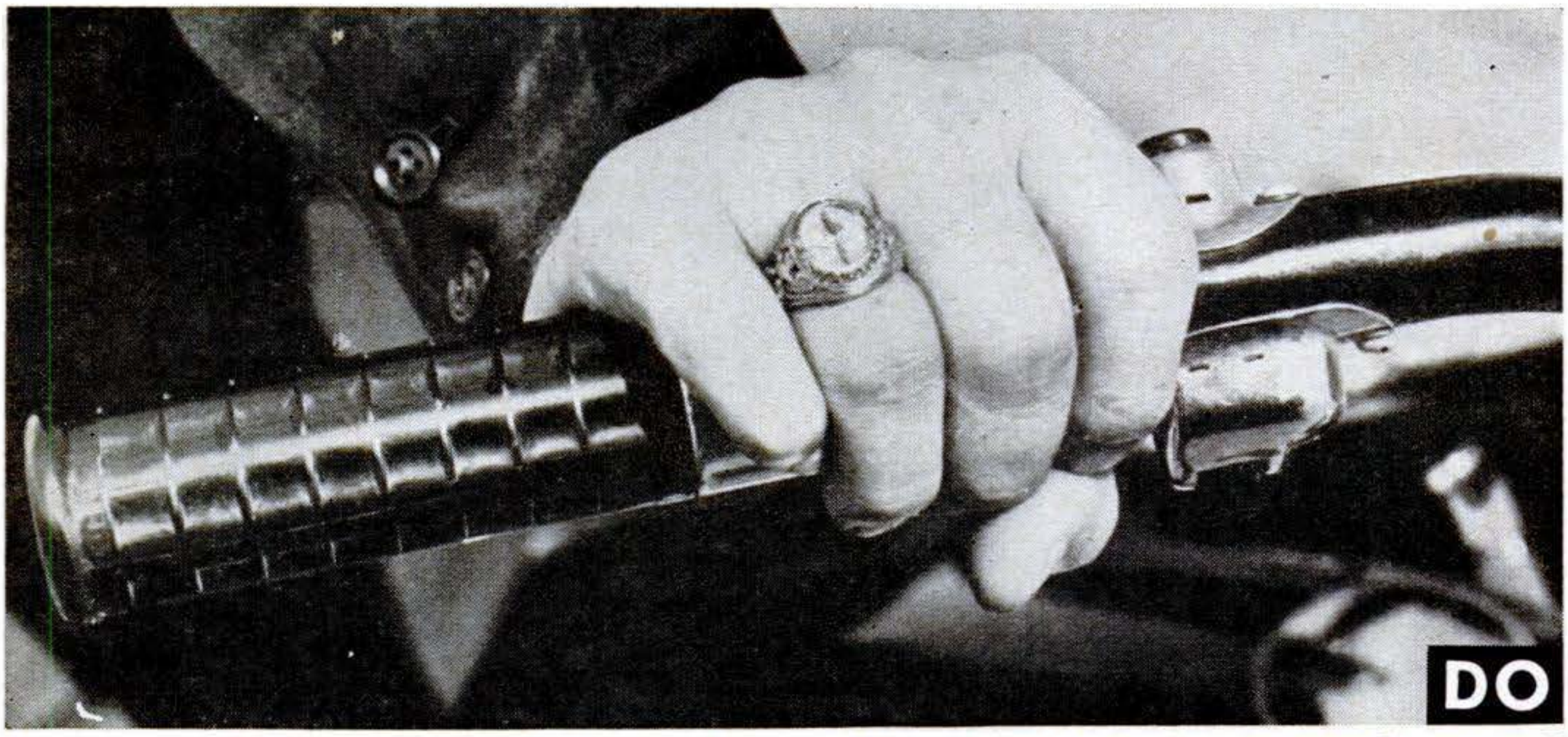
Don't ride double in such a way that you must sit forward on the seat to accommodate the passenger. This also locks you in.

Don't try to "rack up" your motorcycle when parking. This means turning out and sliding the rear end around to halt—you hope—at right angles to the curb or parallel to another motorcycle. If the rear wheel hits an oil spot, scrap of paper, a patch of sand, or a puddle, you may crack up.

Now here are some "do's":

When stopping for more than a minute or two, switch off the engine. It's air-cooled, and if permitted to idle it will heat up—as well as run down the battery.

When stopping, put the shift in neutral, with the clutch engaged. If you leave it in gear with the clutch disengaged and use the throttle, the clutch may drop in—and you'll take off without intending to. Also, if you try to start the motor with the clutch disen-



Keep your right hand up close to the front of the throttle at all times. This will give you greater stability on the motorcycle, as well as provide more certain control of the speed.

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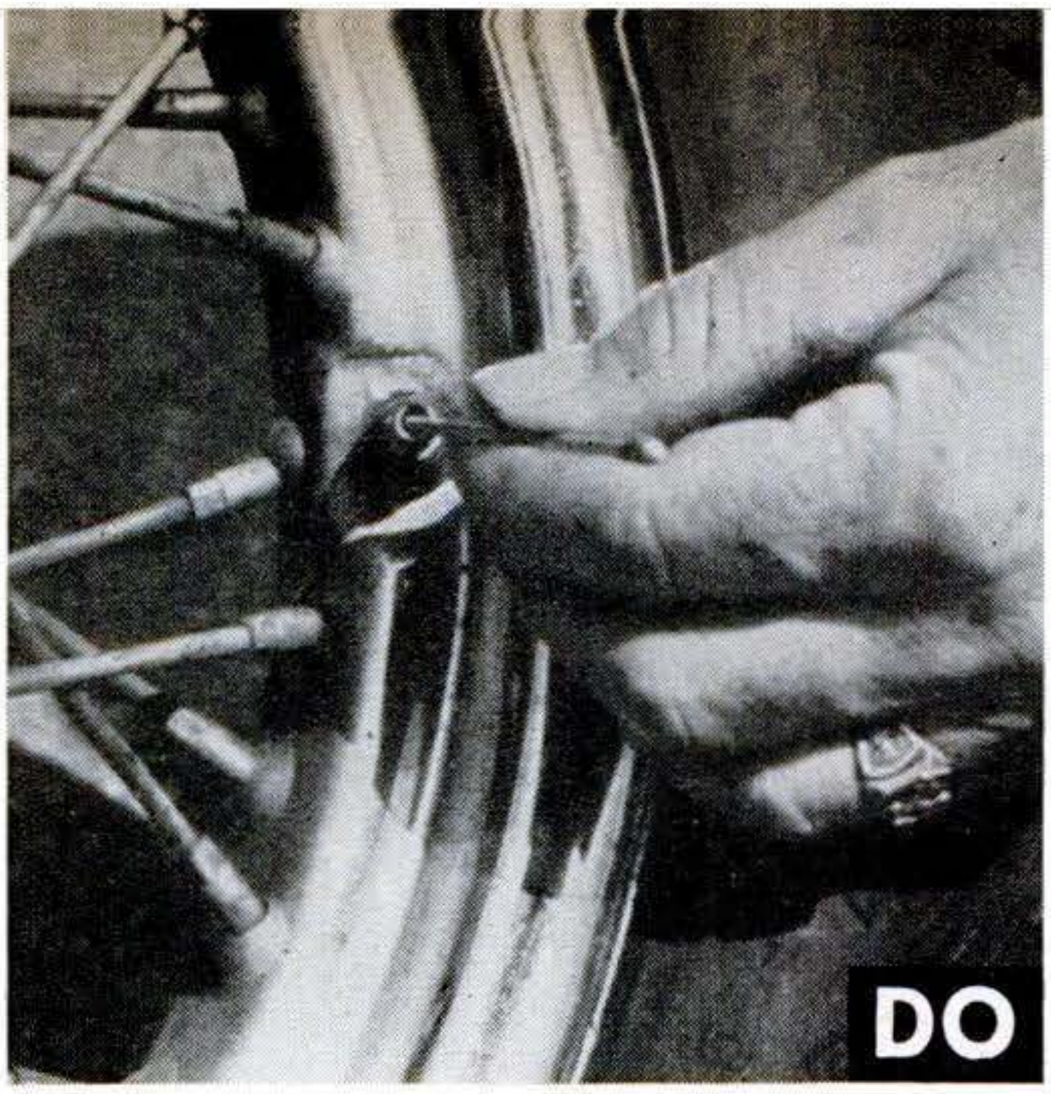
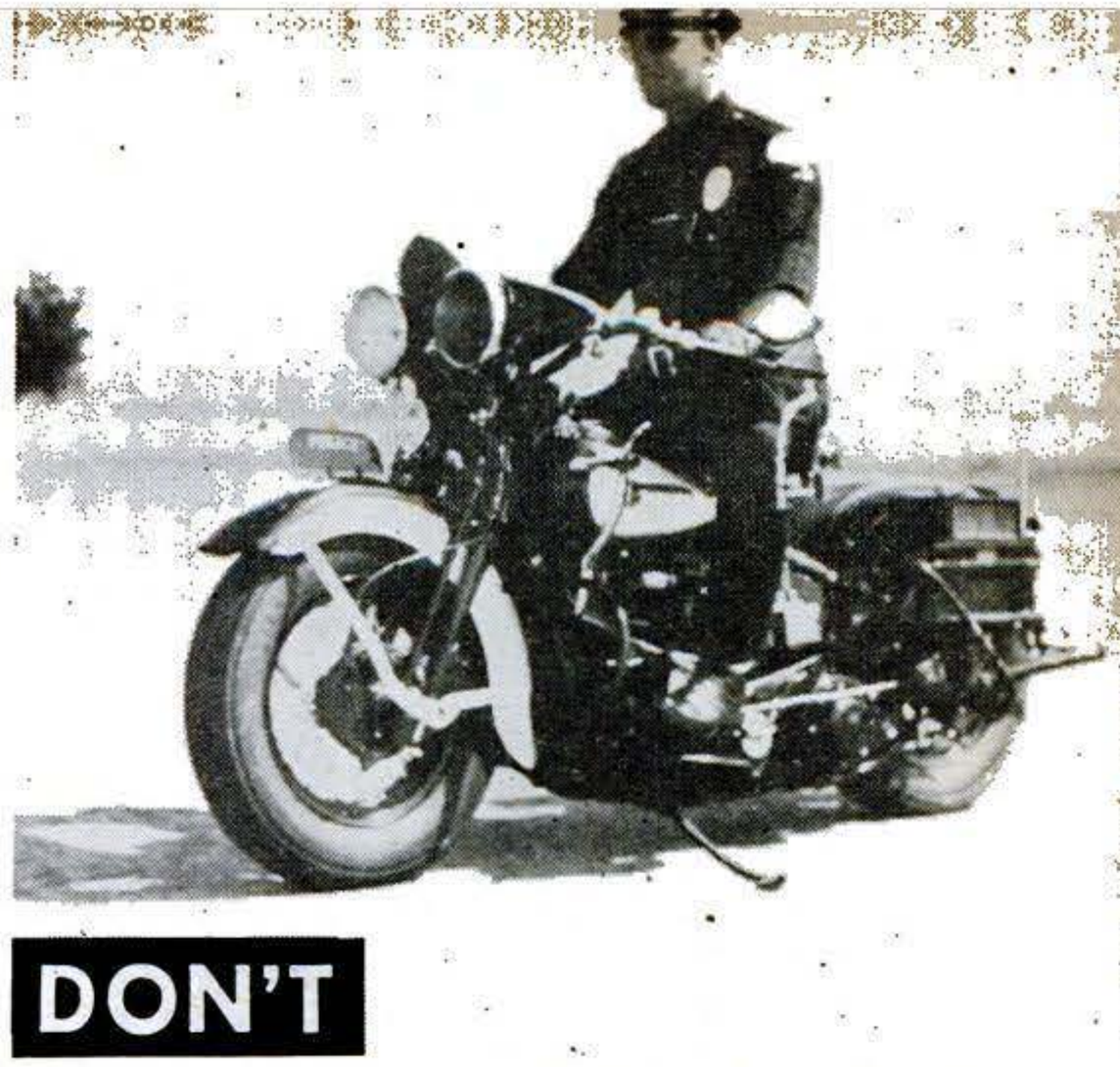


Deflate the tires to about 12-lb. pressure if caught by rain. This lessens risk of skidding.



With the stand extended, this rider is heading for a fall—just as soon as he turns to the left.

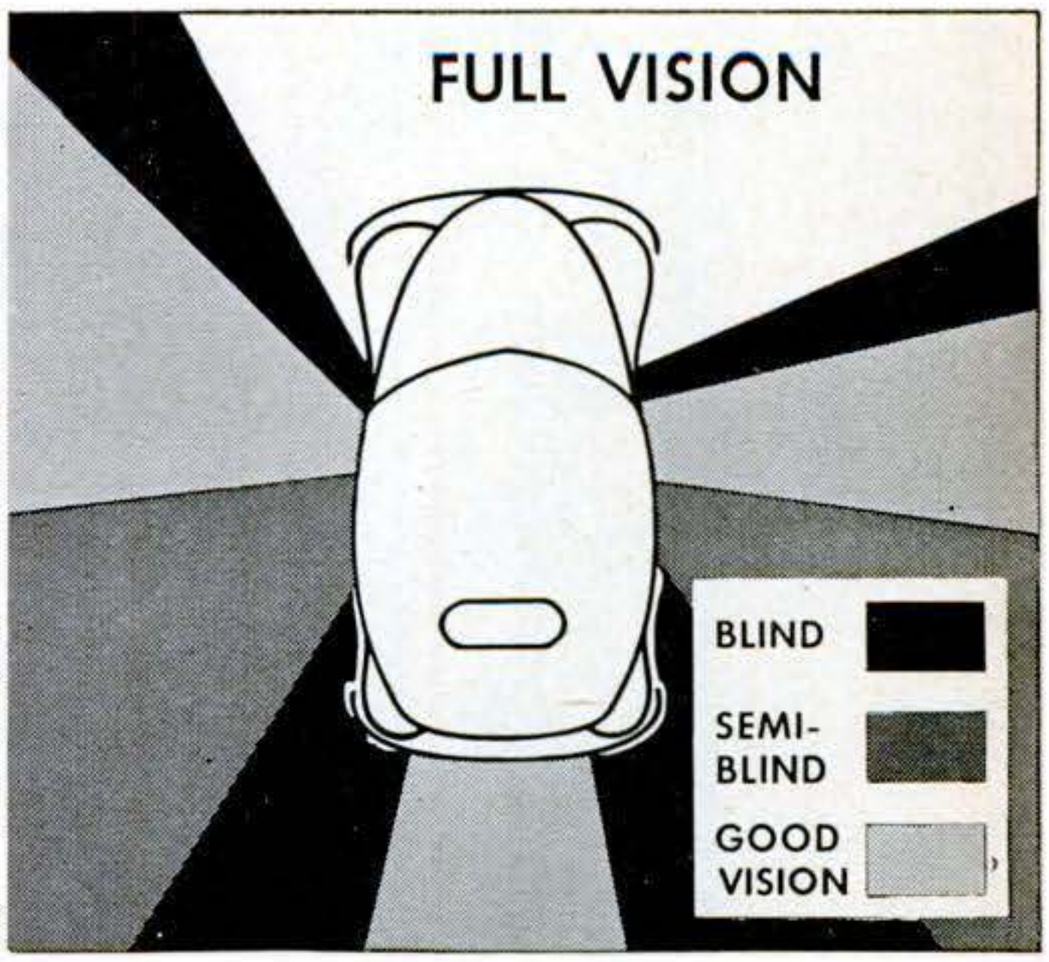
gaged, you'll have no compression against which to thrust. Consequently, when you stamp on the starting pedal, your foot will hit the ground hard and you may injure yourself.

Keep both hands (particularly the throttle hand) well forward on the hand grips. This gives better control and increases stability.

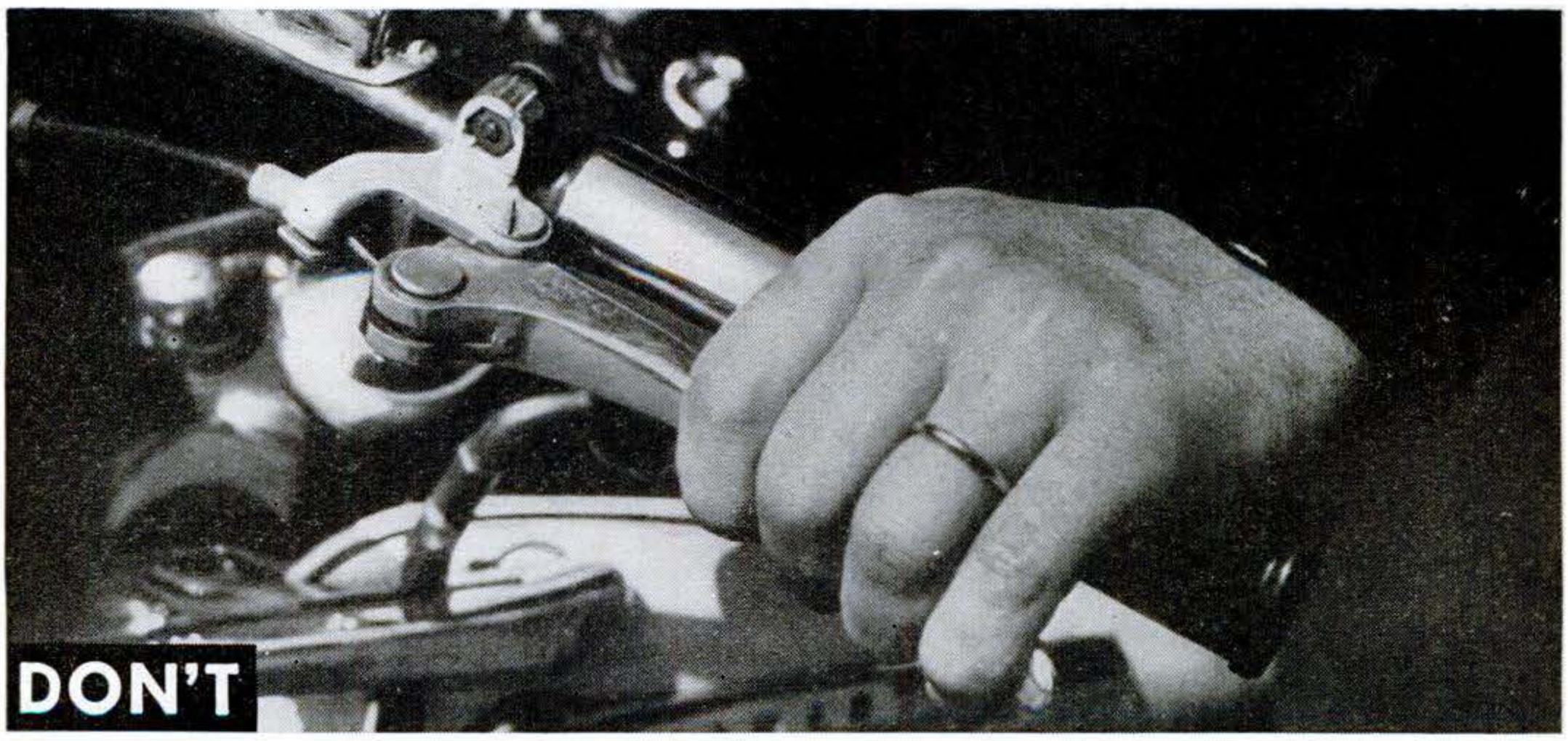
If you're caught out in the rain, stop long enough to deflate your tires from their normal 18 lb. to about 12 lb. This decreases the danger of skidding.

If you must ride through sand, turn only a few degrees at a time. Don't lean, or you will spill.

Watch every car driver like a hawk. There are blind spots where he can't see you—as the accompanying chart shows. END



The blind spots of a car are dangerous places to ride in; a driver won't know you're there.



When the hand brake is applied suddenly on a turn, the rear wheel may slew ahead, causing the rider to spill. It's best to use it only while traveling in virtually a straight line.

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Gus Turns Prophet

Gus's eye was caught by the small metal object he had taken from the pocket of Stan's coveralls; he picked it up from the bench.

When Stan put a car back together and had a piece left over, Gus didn't need a dream book to tell that the customer was coming back mad.

Without Profit

By Martin Bunn

GUS WILSON was first down to the Model Garage that sunny winter morning. Whistling cheerily, he took off his coat and vest and hung them on their accustomed hook. He lifted down a pair of coveralls, wiggled into them—and found them unaccountably tight. "I must be putting on weight," he mused as he reached into a pocket for his tobacco. Instead of the familiar tin of "Delight," his fingers closed on a small metal object. Surprised, he took it out, glanced at it absent-mindedly, and put it down on a workbench. He fumbled in another pocket and fished out the crumpled remains of a pack of chewing gum. Then light broke. "Darn it! These are Stan's coveralls."

Spotting his own coveralls on an adjacent hook, Gus changed into them, found his tobacco, lit his pipe, and began to plan the day's work. After an instant his eye was caught by the metal object he had taken from the pocket of Stan's coveralls; he picked it up from the bench. It was a short, hollow cylinder, with both ends chamfered. After momentary puzzlement he identified it. Then he thought back through the jobs of the previous day. "Gosh!" he exclaimed at a sudden recollection. "Stan cleaned that gas tank and fuel line, and tightened the connections. Now we *will* have fireworks! Why'd it have to be that red-headed Horace Spinker—the worst-tempered man in town?"

Gus, who is blessed with the gift of taking his work seriously in a light-hearted sort of way, laughed and put the little cylinder back in Stan's coverall pocket. Then he hung the garment on its hook and hastened into the office to make a phone call. A woman's voice told him irascibly that Mr. Spinker had left and asked for a message.

"Never mind," Gus replied. "I'll be hearing from him soon enough anyway."

Stan came in a few minutes later, red in the face and out of breath. "You're sorta early, ain't you, boss?"

Gus put on a glum face. "I was glad to get up—bad dreams," he growled. "You believe in dreams, Stan?"

"Me? I dunno."

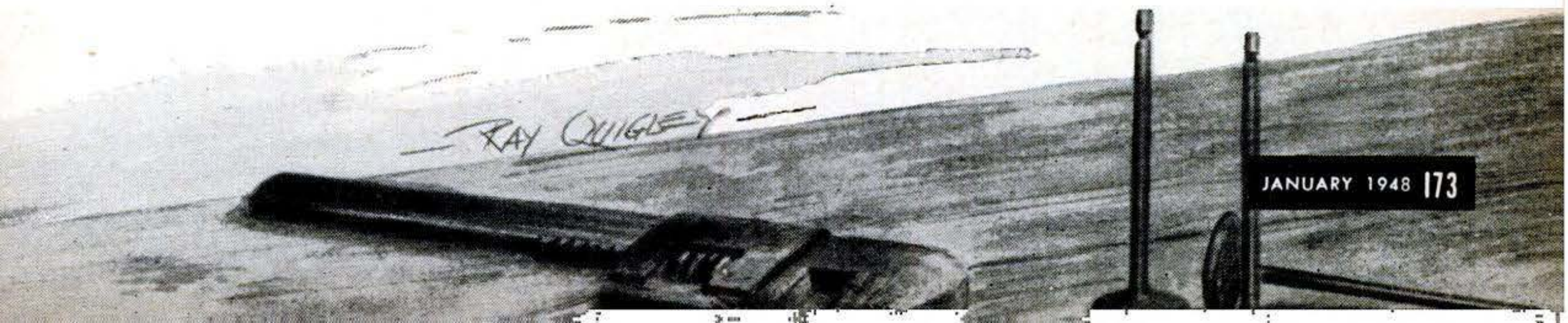
"I had one about you," Gus said. "You sure were on a spot. There was a big fellow with a red face and red hair and red mustache who was going to cut your heart out because you'd fouled up his car. He sure was mad, and—" the master mechanic shook his head forebodingly. "If there's anything in dreams, you'd better watch your step today. I wouldn't want to have a fellow as big as that mad at *me*."

Stan grinned a little nervously. Gus's serious manner had impressed him. "I ain't afraid of dreams," he muttered. "They don't mean nothing."

"I hope you're right," Gus told him somberly. "But I wouldn't bet on it."

IN SPITE of Gus's carefully portentous manner and a doleful yarn or two about dreams that had come true, things went along placidly enough in the shop until about three o'clock, when Joe Clark stuck his head in from the office door and shouted:

"Job for the wrecker! Spinker just phoned



Almost an hour later, Stan drove the wrecker back into the shop with Spinker's car in tow.

that he's stalled five miles up the highway. Says his starter and ignition are O.K. and his gas tank is a third full, but his car quit on him and he can't get it moving again."

"All right—we'll fix him up," Gus called back. Then he turned to Stan. "You do it, will you?" he said. "You worked on Spinker's gas tank and fuel line yesterday."

Stan stared at him, his jaw dropping. "Spinker?" he said weakly. "Say, ain't he that big guy with the red hair and the terrible temper?"

Gus whistled softly. "*Now* I remember," he muttered. "He's the fellow who was after you in that dream. Look here, kid—if you're scared to go—"

On Stan's face there was the look of the men who held Bastogne. "I'll go," he said, and climbed into the wrecker.

ALMOST an hour later he drove back into the shop with Spinker's car in tow. From the sedan the terrible-tempered Horace erupted, his face the hue of underdone roast beef and his stubby red mustache bristling belligerently. "What is this you're running—a clip joint?" he yelled at Gus. "You soak me for fixing my car, and this half-witted grease monkey of yours busts something so it dies on my hands! I'll report this to the Chamber of Commerce—I'll—"

"You'd better throttle down before you bust a blood vessel." Gus turned to Stan, who had got out of the wrecker looking as if he'd had a rough ride. "What's the matter with this bus?"

"I dunno," Stan growled, with a glare at Spinker. "I tried to check it but that screwball kept yelling at me."

Mr. Spinker had taken the shop's only chair. He leaped up again as if the business end of a hornet had made contact. "Screwball!" he howled. "I'll show you—"

Gus placed a large palm on his chest, and straightened his arm. The raging Horace sat down again—hard. "Just take it easy," Gus advised soothingly, "while we find out what's wrong."

Spinker sputtered for half a minute, and then suddenly switched from explosive rage to complaining self-pity. "I've got my living to earn," he moaned. "I've got to see a big customer downtown, and I'm an hour late already!"

"That'll work out swell," Gus told him. "You go ahead and see your customer, and when you get back we'll have your car ready for you. Better not waste any time—the bus is pretty near due, and there won't be another one for half an hour."

Spinker departed, still complaining. Gus grinned at Stan. "We're rid of that pest for a while," he said. "All right, kid—it's your baby."

HE WENT back to the job he had been working on, and Stan started to check Spinker's sedan. After making certain that

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there was as much gasoline in the tank as the gauge indicated, he carefully examined the pump and the flexible coupling hose, and blew back on the fuel line. Obviously gasoline wasn't getting to the pump—it was as dry as a bone.

While he was scratching his head over the puzzle, Gus strolled over to him. "I haven't found it yet, boss," Stan admitted.

"Look in your pocket," Gus said.

"Huh?"

"Look in your pocket—your right-hand pants pocket."

Stan stared at his employer in deep puzzlement; then he felt in the pocket indicated, and after a moment fished out the little metal cylinder. As he looked at it his face flushed a fine brick red. "Holy cat!" he groaned.

"It's a good rule," Gus suggested mildly, "to put back anything you take off a car."

"I know, boss," Stan said contritely. "But this little do-funny dropped out of somewhere while I was working on the fuel-line connections yesterday afternoon. You were out and I couldn't find where it came from, so I put it in my pocket until I could ask you. Then I forgot about it until just now . . . Say, how th' heck did you know it *was* in my pocket?"

"I might have dreamed it," Gus told him with a grin, "but actually I found it in your coveralls this morning when I put 'em on by mistake. Remembering that you had worked on Spinker's car yesterday, I knew you were going to have trouble with a hot-tempered redhead."

Faint hope of an alibi brightened Stan's face. "Say, boss," he offered, "it couldn't have been my leaving this jigger off that made Spinker's bus stall. I road-tested it when I got finished yesterday, and he told me he didn't have any trouble until it coughed a couple of times and went dead on the way back from Centerville."

"Spinker told us he needed the car in time for an early start to Centerville," Gus said. "When I happened on that do-funny, as you call it, I figured he'd run into trouble on the way home, but it was too late to do anything to prevent it. So—"

"Wait—wait a minute, boss," Stan gulped. "You say you knew when Spinker's car was going to stall. How th' heck—"

Gus picked the little metal cylinder out of Stan's hand, and increased the grease monkey's suspense by relighting his pipe before talking. "This little gadget," he explained, "called a ferrule, is supposed to form a seal between the fuel line and the internal tank connection, and so prevent gas from getting out and air from getting in. It fits in under the connector, and the chamfers at both ends of it are to seal the lips of the fuel and connection lines. Get it?"

"Yeah—I see," Stan said. "But I don't see how you knew—"

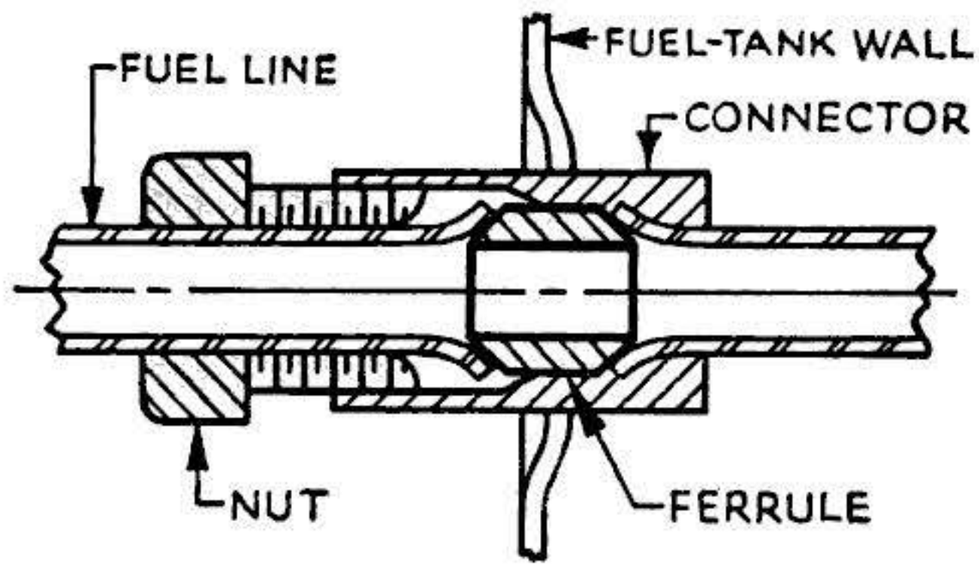
"I'm telling you," Gus went on. "On Spinker's car the connection is about three inches above the tank bottom. While the tank is at least one-third full it doesn't make any great difference whether or not the ferrule is in because air can't leak into the system. But when the gasoline falls below the connection, air is drawn in and the fuel supply to the carburetor is cut off. Spinker had the tank filled when he called for the car last night. Knowing he was starting with a full tank, and that without the ferrule he'd be stalled when two-thirds of the gasoline was gone, it wasn't hard to figure he'd run into grief on the way home."

Joe Clark had come into the shop while Gus was talking. "You're a red-hot prophet, aren't you?" he said.

Gus wrote out a time slip covering the job, scrawled "no charge" on it, and handed it over to his partner with a grin. "Sure," he admitted, "but on this job prophecy is on the house!" END

Ferrule Bars Air from Gas Line

On some cars a small ferrule, chamfered at both ends, is used to insure an airtight seal at the point where the fuel line joins the tank. With this ferrule omitted, gasoline can be drawn out by the pump only while the fuel in the tank is above the imperfect coupling. When it falls below, air is sucked in and the fuel pump fails to deliver.



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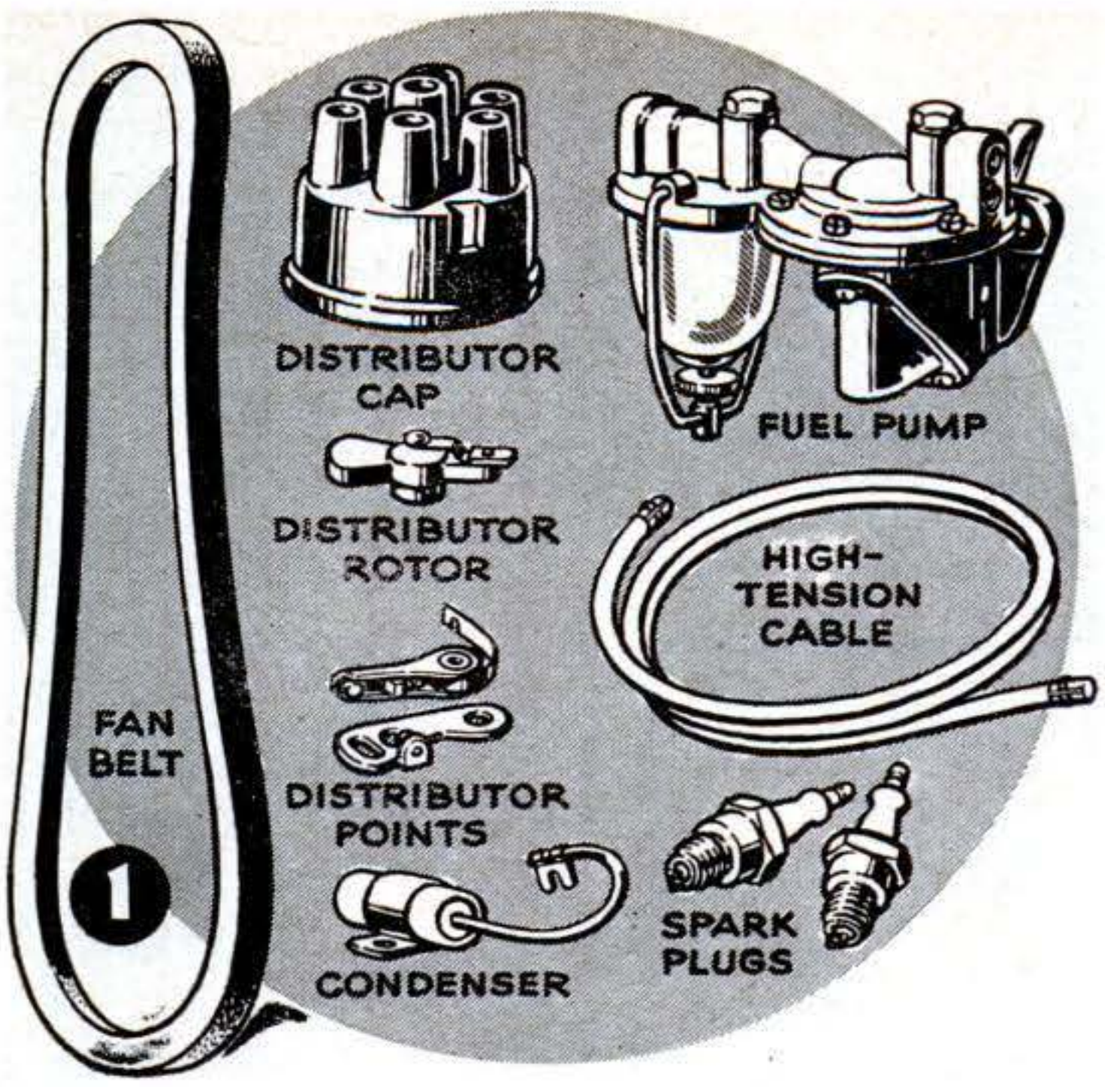
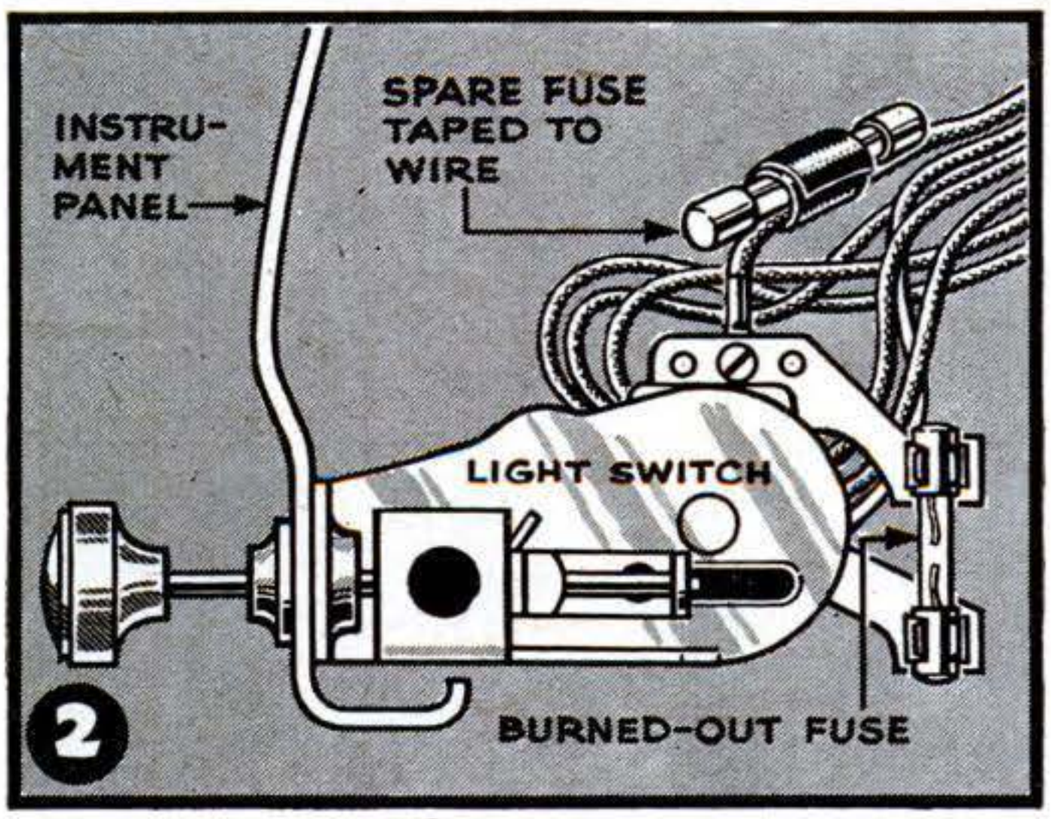
AUTO HINTS

1. Spare Parts Pay Off. Some years ago I adopted the practice of always carrying this kit of spare parts, and at one time or another I have found a use for each item. Even if someone else makes the repairs, it is often a timesaver to have the necessary part readily available. Incidentally, the cable, long enough to reach from the coil to distributor, may sometimes be the means of starting the car when the original has become wet.—WALTON E. BRIGGS.

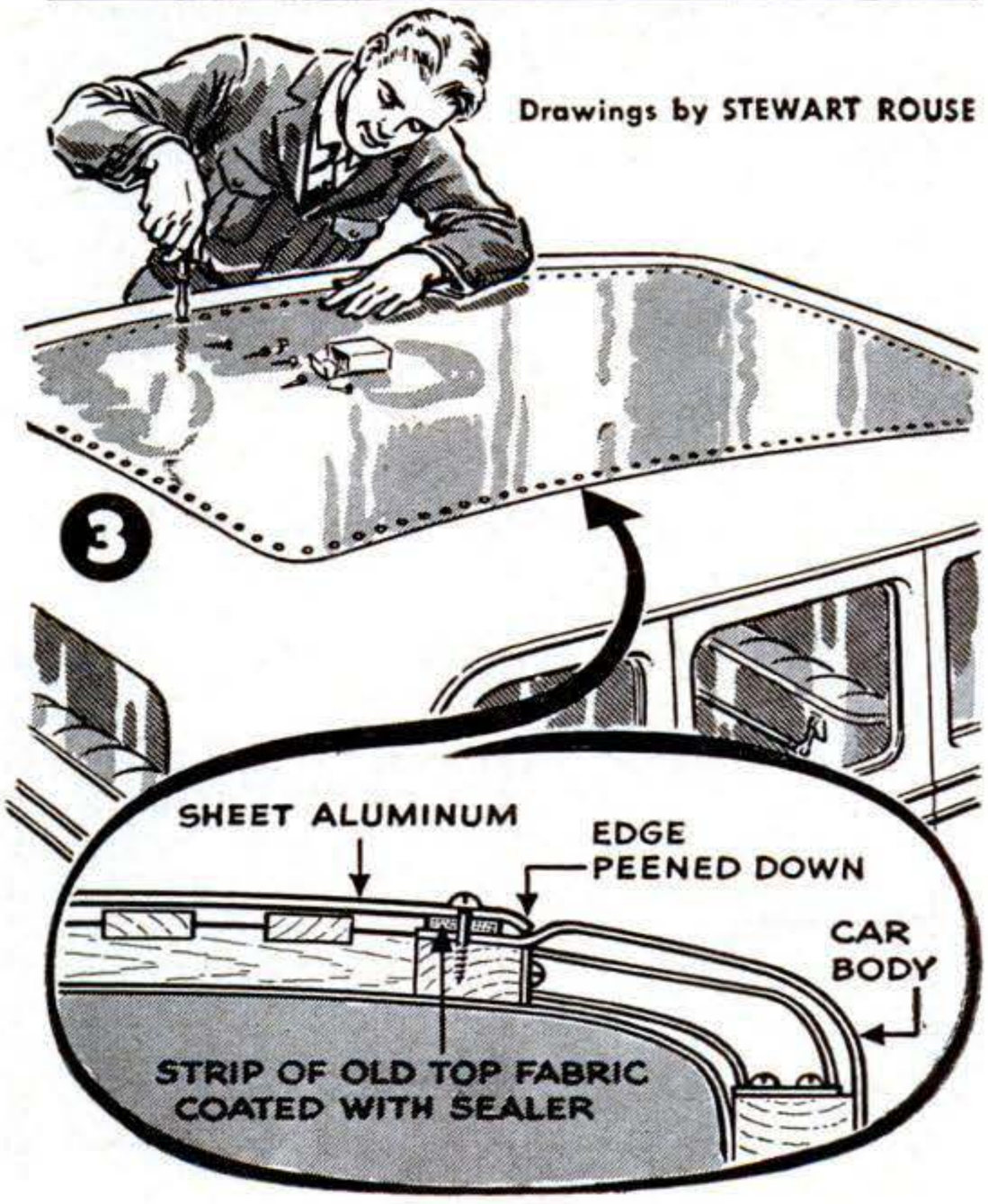


2. Keep Extra Fuse Handy. A fuse seldom blows on a car, but when it does you may be out of luck if you haven't another. A good idea is to tape a spare to a wire leading from the fuse or at some other adjacent point.—J. O. SACKERSON.

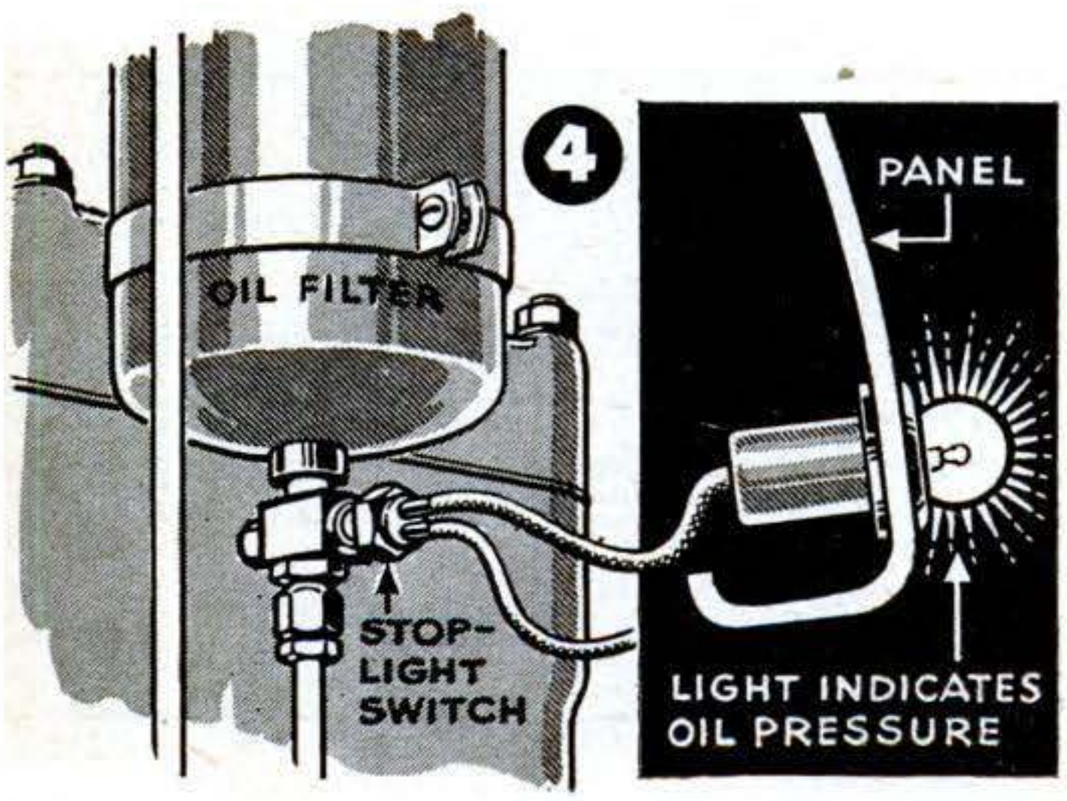


3. Aluminum Used for Top. A new car roof may be made from a 4′ by 6′ sheet of war-surplus aluminum. Using the old roof as a pattern, I cut the aluminum ¾″ wider all around. Then I peened down the edge, cut strips from the old fabric top, coated them with sealer, placed them around the edge, and fastened the aluminum with brass screws spaced 1½″ apart. The roof is perfectly rainproof.—HOWARD CARE.

Drawings by STEWART ROUSE



4. Light Shows Oil Pressure. Unable to buy a new oil-pressure gauge, I installed a hydraulic stop-light switch on an oil line, ran a lead from the hot ammeter terminal to one side of the switch, and a wire from the other side to a light on the dash. As long as there is sufficient oil pressure, the light glows.—JAMES SWAIT.



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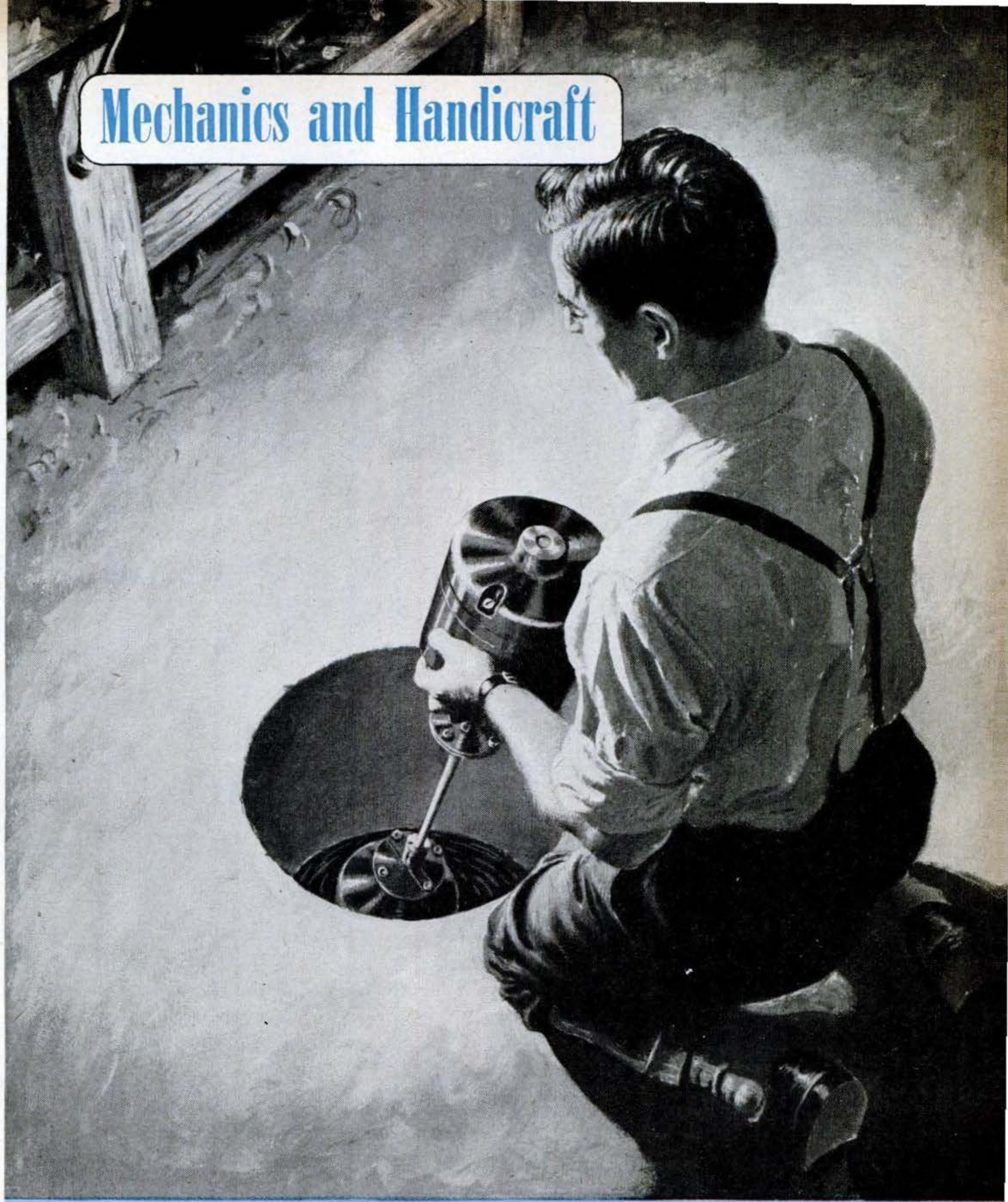
Mechanics and Handicraft



Model White Steam Car PAGE 178

Danger! 115 Volts PAGE 186

Get Started in Woodworking PAGE 200

Pumps You Can Make PAGE 207

One-Tube Record Players PAGE 222

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Upholstered seats and bright paint help give it the appearance of the original White steamer.

1905 Steam Car Is Handsome

By Herbert Lozier

BACK in the early days of the automobile, gasoline, steam, and electricity competed for supremacy as the source of motive power. Before gasoline finally won out, many efficient steam cars had been produced, among them the 1905 Model E White steamer that is the prototype of this model.

Built to a scale of about ¾″ to 1′, the model is complete in most details, although a few are omitted for the sake of simplicity. Nevertheless, it may be considered a good copy of the original.

Before going into actual construction, it is well to remember that inaccuracies are likely to occur when the plans are being traced or drawn to scale. Consequently, all parts should be carefully checked and, if necessary, trimmed to size before being assembled.

Cardboard, wood, and metal are all suitable materials for the model. In the accompanying drawings, wood and Bristol board (a smooth, heavy drawing paper) are speci-

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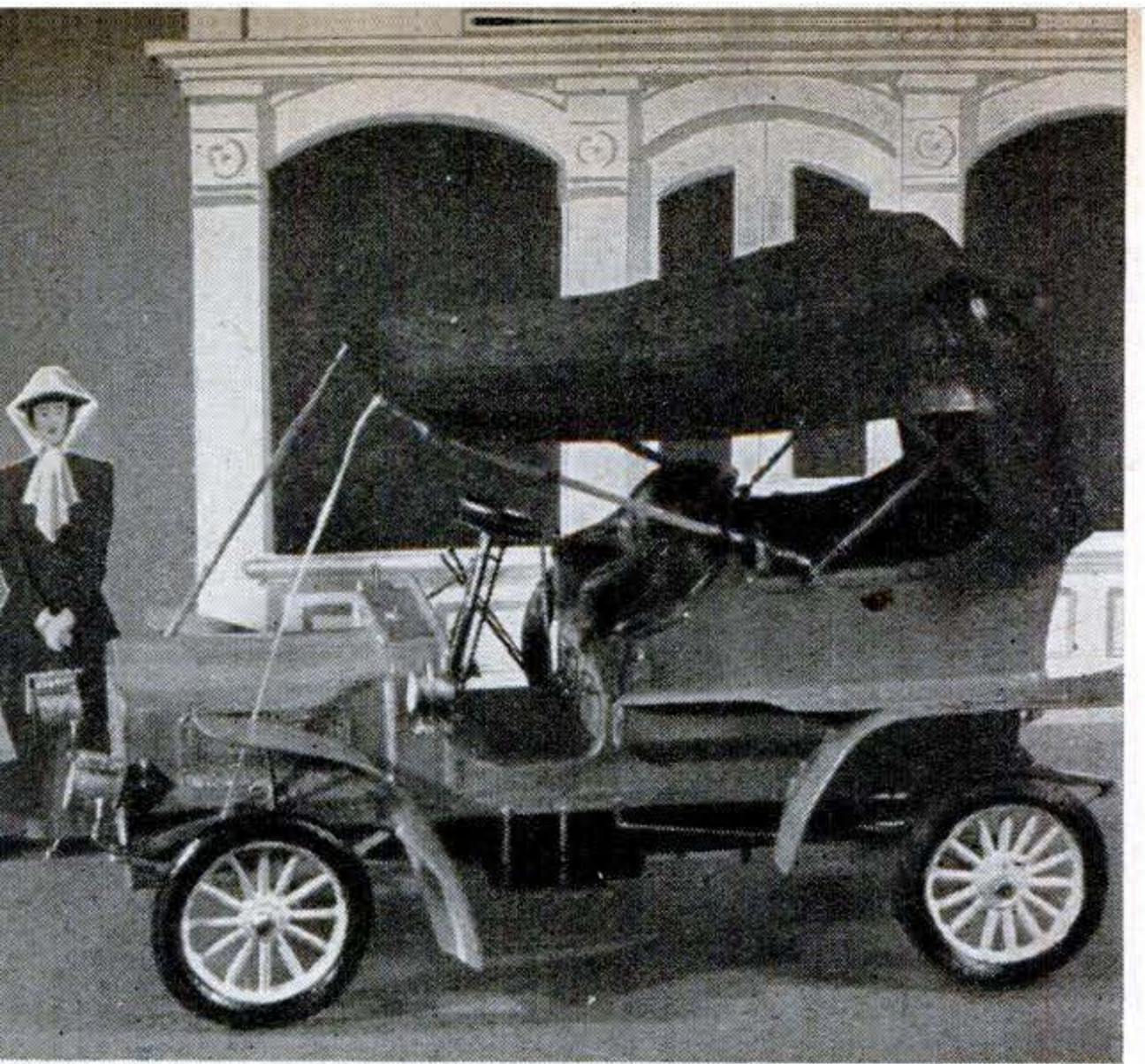

Details are complete down to door handles.

Mantel Model

fied in most cases and the parts are to be assembled with glue. However, the more advanced modelmaker may wish to use brass for greater durability when he makes the various parts.

Begin with the chassis. Cut the two side-pieces to the shape shown in the side view on page 181 from 1/16″ by ¼″ by 8⅛″ wood. Also cut the three 1/16″ by 3/16″ by 2¼″ wood cross members. After sandpapering, glue these parts together, locating one cross-piece 1″ from the front, another 1⅝″ from this, and the third ¾″ from the rear. After making certain that the chassis lines up and is square, allow it to dry thoroughly on a flat board.

Springs Are Bent from Cardboard

Next come the springs. These may be three cardboard strips ⅛″ wide glued together after being bent to a gentle curve. Cut one strip 2¼″ long, the second ⅜″ less, and the third 5/16″ less than the second. It is important that all four springs have the same curve. Otherwise, the model will not stand straight. Shackles go on the front of the rear springs and the rear of the front springs. These are small hooks bent from paper clips.

Cut a piece of cardboard 2⅜″ by 4⅝″ and glue it to the top of the chassis at the rear to provide a floor. Glued under this floor are two pieces of wood that represent the under-mechanism covers, the bottom of each being rounded off. One piece, measuring ¾″ by 1¾″ by 1¾″, is located in the center 2 1/16″ from the rear of the chassis. Directly ahead of this glue a ⅝″ by 1″ by 2″ piece, positioning the 2″ dimension vertically and rounding off the bottom corners. Then cut the cardboard pan to the pattern on page 180, bend it to a curve, and glue between the chassis, placing the upper edges on line with the top of the chassis and bringing the rear edge up against the second wood block already installed.

Axles Made in Several Ways

Now for the axles. The rear one may be made in any one of three ways. Perhaps the easiest may be to turn it from a dowel 4⅛″ long and about ⅝″ in diameter to the dimensions given on page 180. It also might be made simply by winding and gluing paper around ⅛″ wire or dowel to build up the center sections to the indicated diameters. Or it may consist of a ¾″ section of 9/16″ dowel drilled through the center for a ⅛″ dowel 4⅛″ long, the 3/16″ and ¼″ diameters being built up with paper. Braces of piano wire fitted into holes drilled through the axle complete the job. Glue the axle to the center of the rear springs.

Fit and glue the propeller shaft between the axle and the rear face of the wood block previously installed, the shaft being 3/16″ dowel turned down to ⅛″ in diameter for about one third of its length forward.

For the front axle, bend ⅛″ wire so that the center forms a half circle with a 7/16″ radius and cut the ends for an overall length

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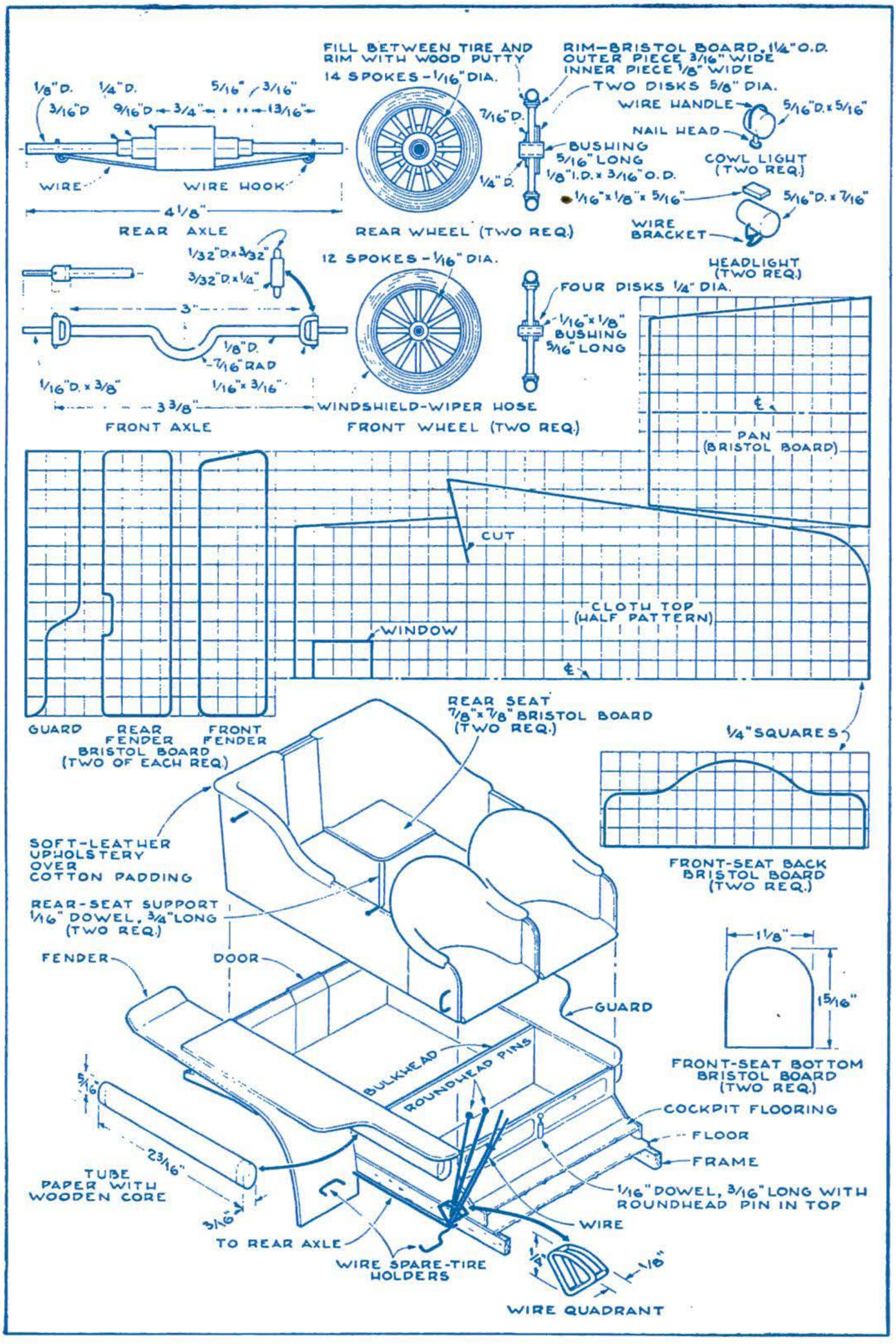

Locate the two roundhead-pin controls inside the quadrant, the two-wire brake lever outside.

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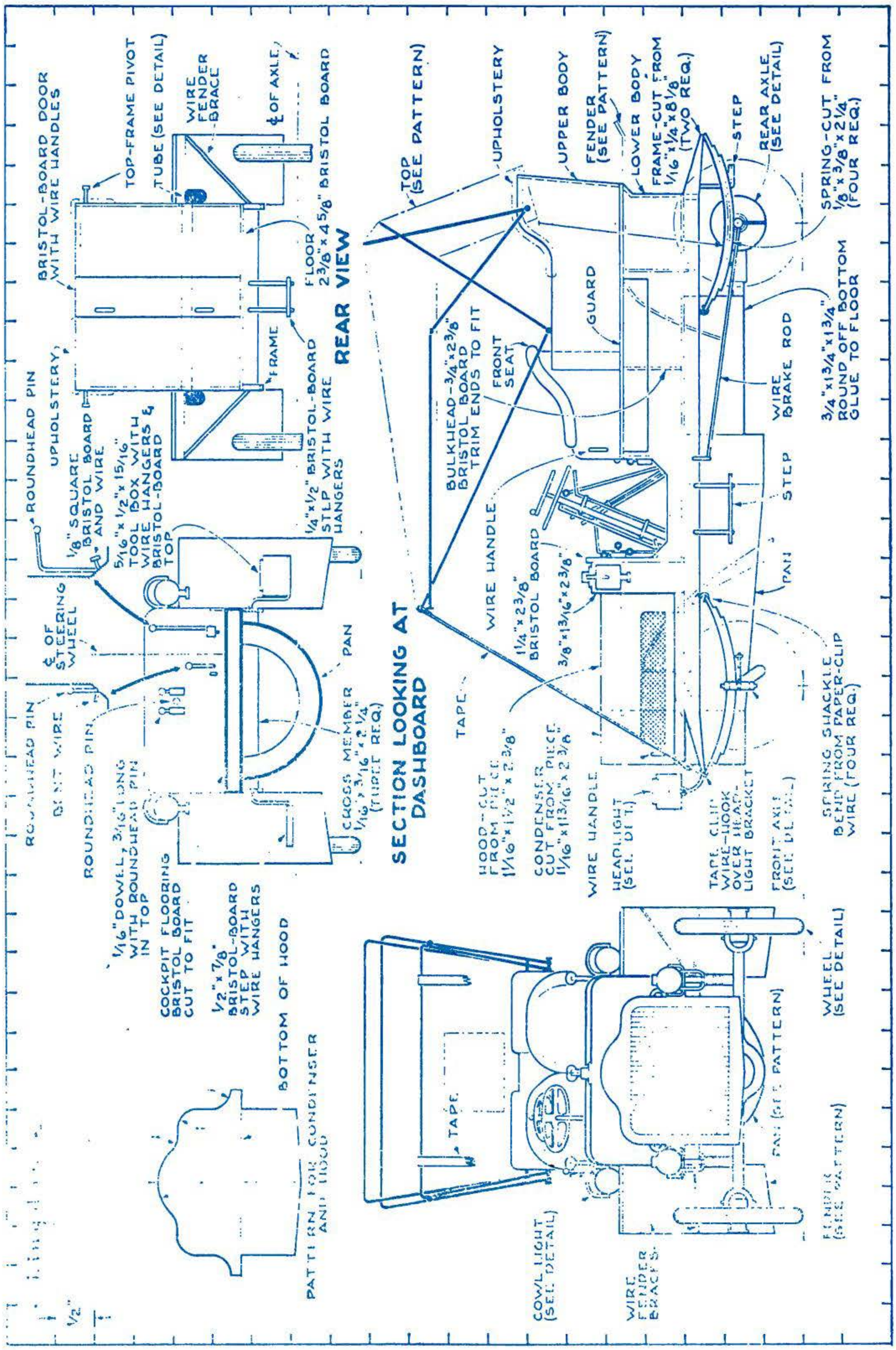

Dimensions of the lower and upper body may be taken from the side view in these drawings.

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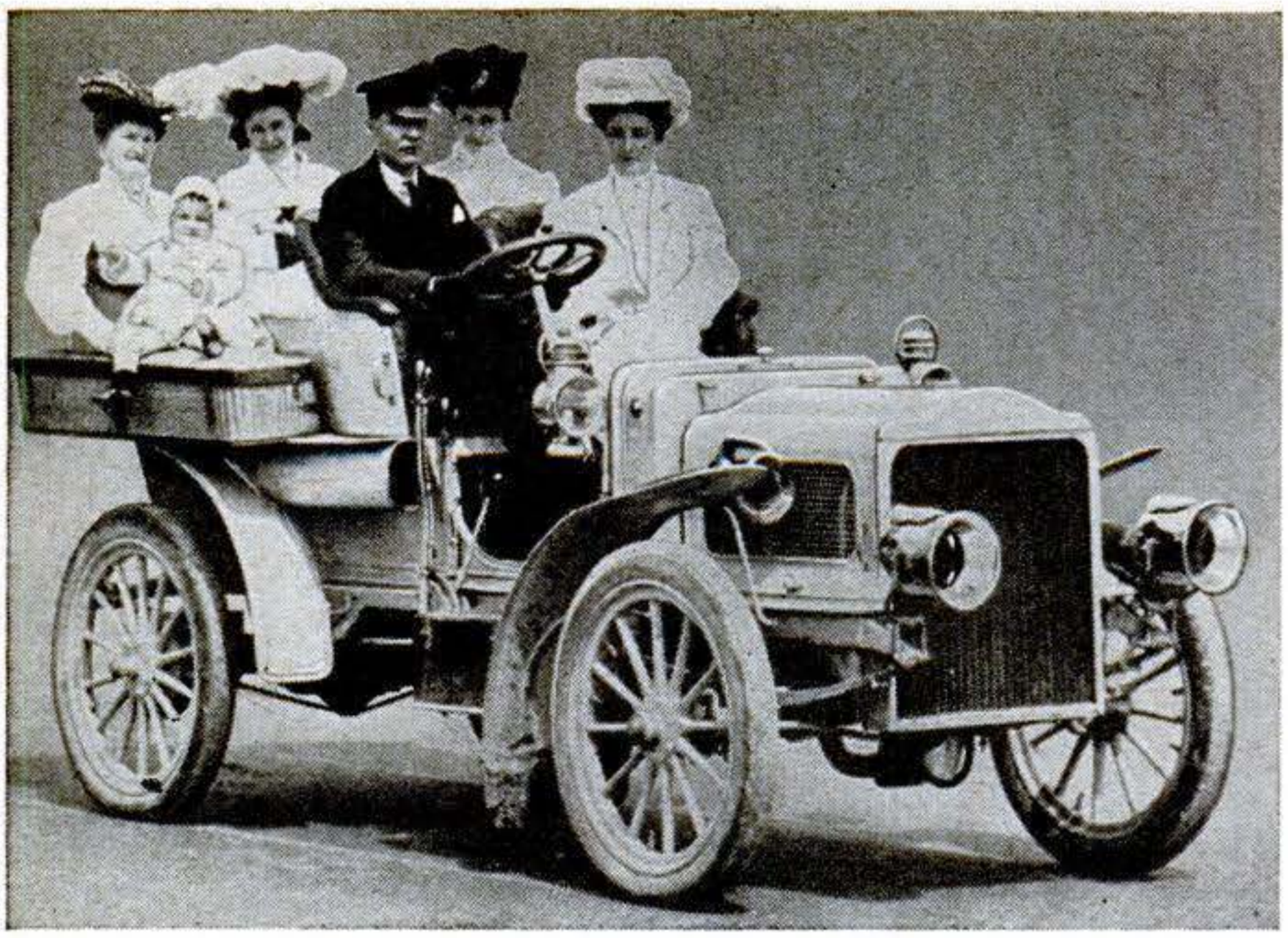

This original Model E was photographed during a 1905 Florida racing carnival. It was built by the White Sewing Machine Co.

You are now ready for the lower body. First cut two cardboard sidepieces, taking the pattern and dimensions from the side view on page 181. Also cut the rear crosspiece of this assembly, as shown in the rear view (the door may be indicated by inked lines). Glue these three parts in place, the front ends of the sidepieces going flush against the dashboard. Now cut the cockpit flooring to fit, bend it as indicated by the dotted lines in the side view, and glue between the sidepieces.

This is a good point to install the dowel and pin dashboard instruments indicated on the dashboard section on page 181, as well as all other controls. Use a 1/16″ by 1 1/2″ dowel for the steering shaft, paralleling it with two wires as seen in the side view. Atop the shaft locate two cardboard wheels, one 7/8″ in diameter and the top one 5/8″, separating with a dowel. Make and put in place the side and back steps, the toolbox, the headlights, the wire brake rods, the bulkhead, fenders, guards, the tubes that go under the guards, and the wire hooks that support the spare tire.

Upholster both the front and rear seats before putting them in place, using soft leather (as from a pair of old gloves) of any color available. After cutting the backs and bottoms of the front seats to the given patterns, bend each back around a bottom piece and glue. Cut the leather to fit, and glue it on, leaving a space open to stuff in cotton. Then glue the open space down. The leather is rolled over the upper edge of the back. Cut and upholster the rear in the same way, using a separate piece for the rear door. Before gluing down the rear body, install cloth on the floor as a rug.

Supports for the top may be bent from wire—or from bamboo shaped over an electric iron. If you want a folding top, install hinges at all the joints. Otherwise, simply cement the frame together. Cut the top covering from cloth and add a cellophane window in the rear.

You may prefer your own color scheme, but the original had red upholstery, a black top, red body, white wheels, and black tires. The lamps are brass. END

of 3″. Bend 1/16″ by 3/16″ strips of cardboard to a U-shape, cement to the ends of the axle, and between each U glue the T-shaped steering-knuckle assembly, made of thin dowels. If desired, metal may be used throughout, the parts being soldered and tie-rod arms and a tie rod attached to a movable steering knuckle so the wheels will steer. In any case, make the tie rod and arms of wire. In gluing the axle to the springs, position it so the center U slopes back as in the side view on page 181.

Wheels are built up of cardboard rims, dowel spokes, and bushings made by wrapping paper around a dowel. Over the bushings press and glue cardboard disks as indicated. Around the rims cement windshield-wiper hose, filling in with putty. The spare tire is tubing glued on a rim without spokes.

Since a boiler was located at the front of a White steamer, the grille that you see is actually a condenser instead of a radiator. The condenser may be carved to the section pattern on page 181 from wood 11/16″ by 1 13/16″ by 2 3/8″, with grille lines drawn in India ink. Likewise, the hood may be carved from a piece 1 1/16″ by 1 1/2″ by 2 3/8″. Paste on gauze to represent the side screen, or draw it in with ink. Glue the condenser and hood to the chassis, locating the former even with the front of the chassis.

Directly behind the hood, glue a cowl piece 3/8″ by 1 3/16″ by 2 3/8″ after rounding off the upper corners. On top of this and centered, glue a disk and short dowel to represent the filler cap. At either side, locate cowl lights as on page 180.

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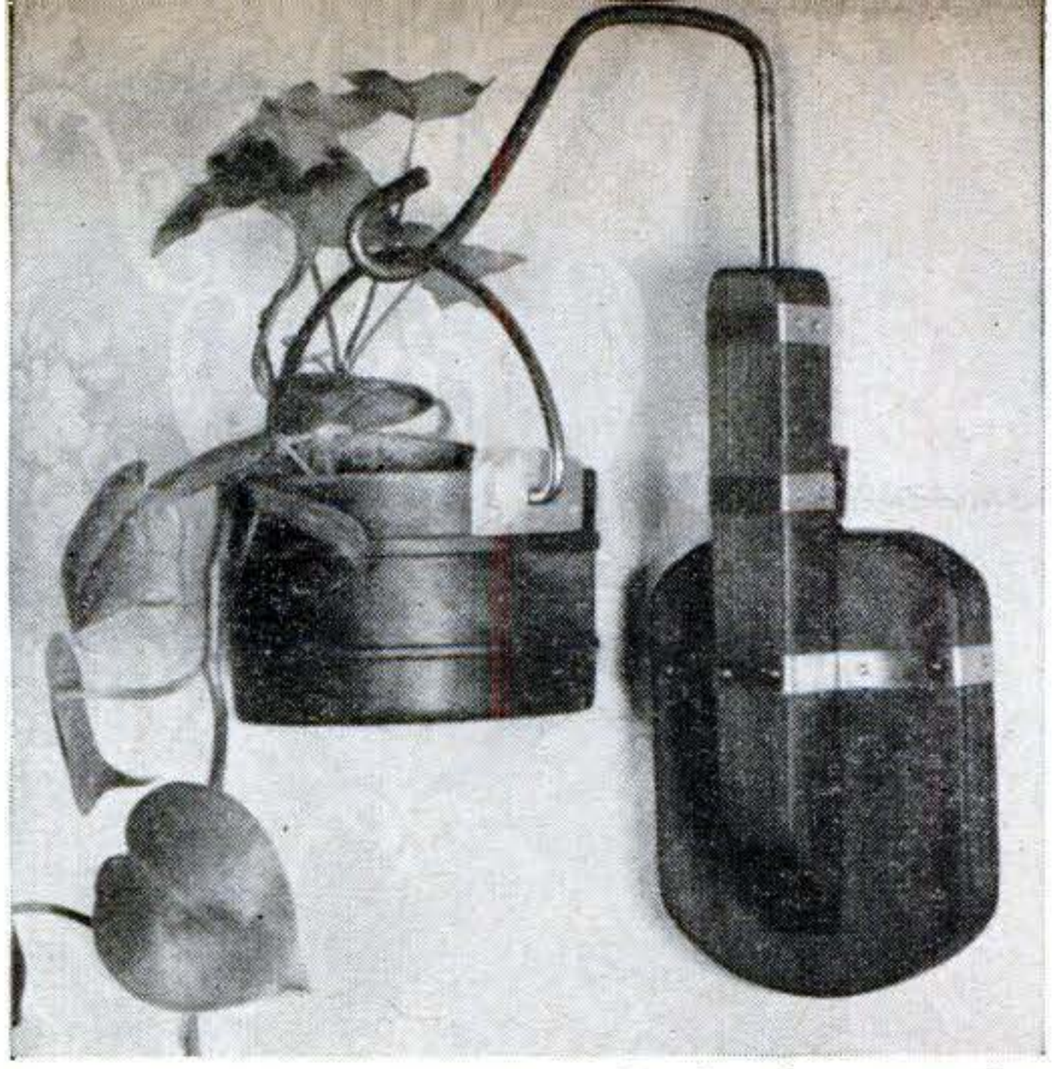


Supported by a bracket, the bucket provides a handsome receptacle for ivy or small plants.

Cigarettes may be served in the bucket if you prefer. Give the black walnut an oil finish.

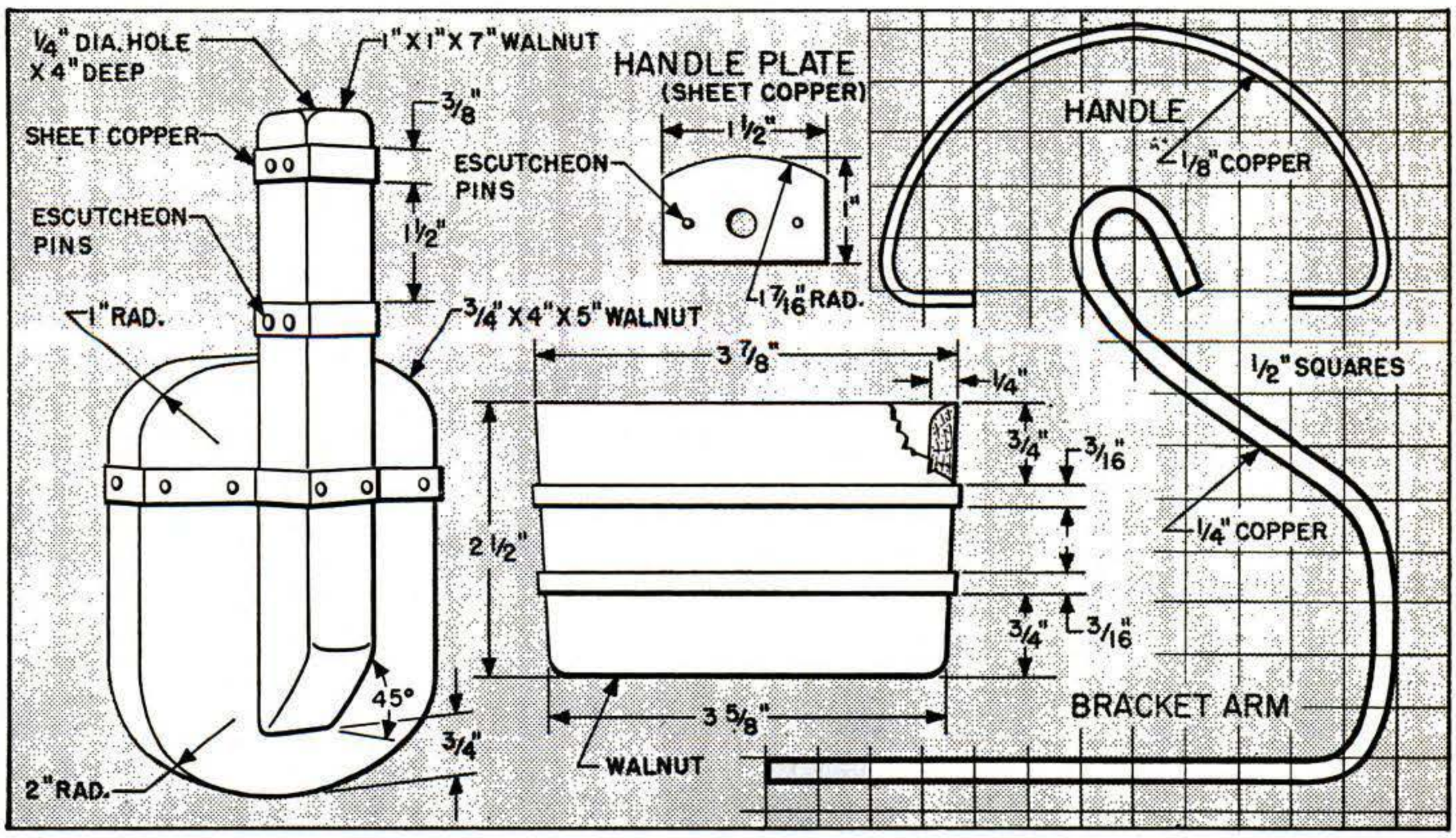
Oaken Bucket Goes Modern

DRESSED up in black walnut and polished copper, this small copy of the old oaken bucket now hangs from a wall bracket and holds ivy or a small plant. Alone, it may be used for cigarettes.

All the necessary materials probably can be found in your scrap box. If you avoid a gluing job by turning the bucket from a solid block, the entire project can be completed in a few hours. Should it be necessary to glue up a turning blank, cut and shape the two walnut parts of the bracket while the glue is drying.

Join the bracket members with wood screws countersunk in the back. Ornament the bracket with ⅜″ bands of sheet copper attached with escutcheon pins. Drive a wire staple into the back of the ¾″ by 4″ by 5″ piece near the top edge and bend it upward to support the bracket on the wall. Near the bottom insert a shortened brad with its sharp end protruding to prevent swinging.

Bend the arm and bucket handle from ¼″ and ⅛″ copper rod respectively, and cut the handle plate from sheet copper. Line the bucket with metal, or hunt up a can that will fit.—R. J. DeCristoforo.



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Units match neatly when placed end to end, but they also look well when used separately.

Here's One for the Books . . .

Unit Shelves Paneled with Aluminum

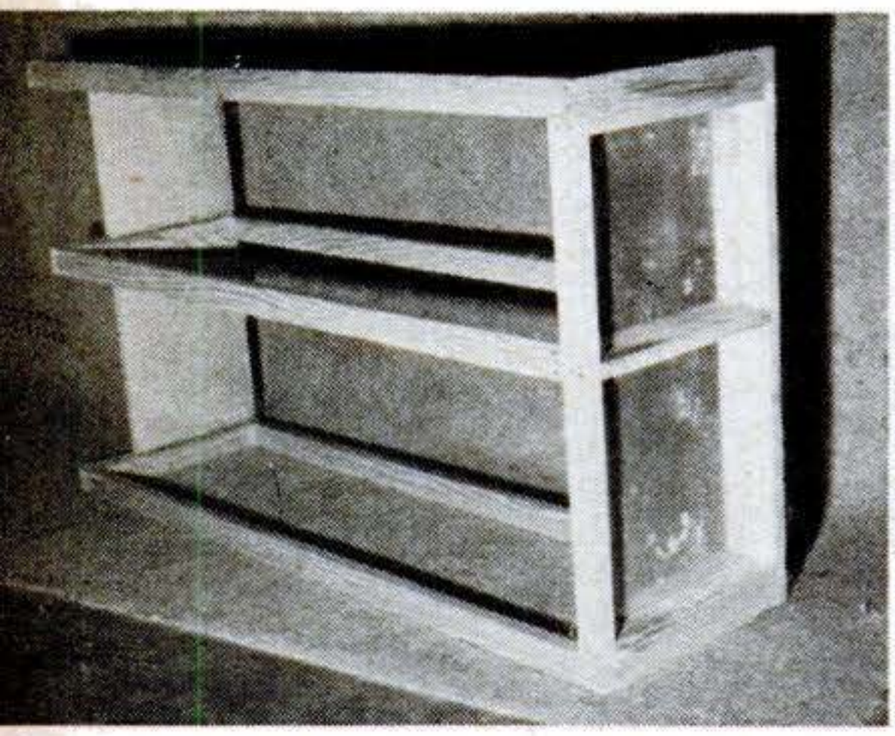
By Wayne Snowden

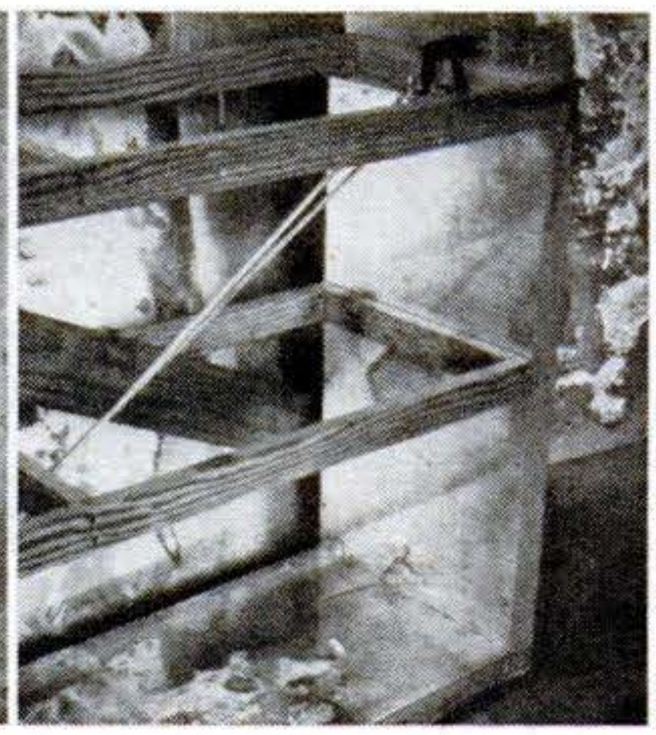
SCARCITY of materials and high prices have never eased the lot of the workshopper, but they do invite you to try new and different ways of building your favorite projects. When an idea for unit bookcases bogged down in a shortage of suitable wood, some inexpensive .051″ thick war-surplus aluminum came to the rescue and proved to have a number of important advantages. Even thinner stock would serve. Unlike most wood, aluminum gives you a practically ready-made surface; it is also strong, light in weight, costs relatively little, and is easy to work with.

Plywood and aluminum panels are laid over a frame built of ¾″ by 1¾″ lumber. Since the panels both conceal and strengthen the frame, butt joints and wood screws are used throughout, and no special pains need be taken with the frame stock except to see that it is braced square until the panels are in place.

If you can buy your aluminum sheets cut to exact size, by all means do so because power shears give the cleanest cut. But if this isn't feasible, simply scribe sharp and fairly deep dimension lines and break the metal along these lines. The resulting rough but straight edge is easily smoothed with a file. For trimming off strips less than 1″ wide it may be necessary to use hand shears, but it is advisable to avoid this if you can because it is a laborious job and may buckle the edge.

Assemble the top, bottom, and end frame members; before installing the center-shelf





Right-hand unit, above, is a mirror image of the left-side piece shown in the drawing. Face the inside end with aluminum and attach braces to keep the frame square. Center-shelf frame is then fastened to the side through the aluminum. Finally, add the back and shelf panels.

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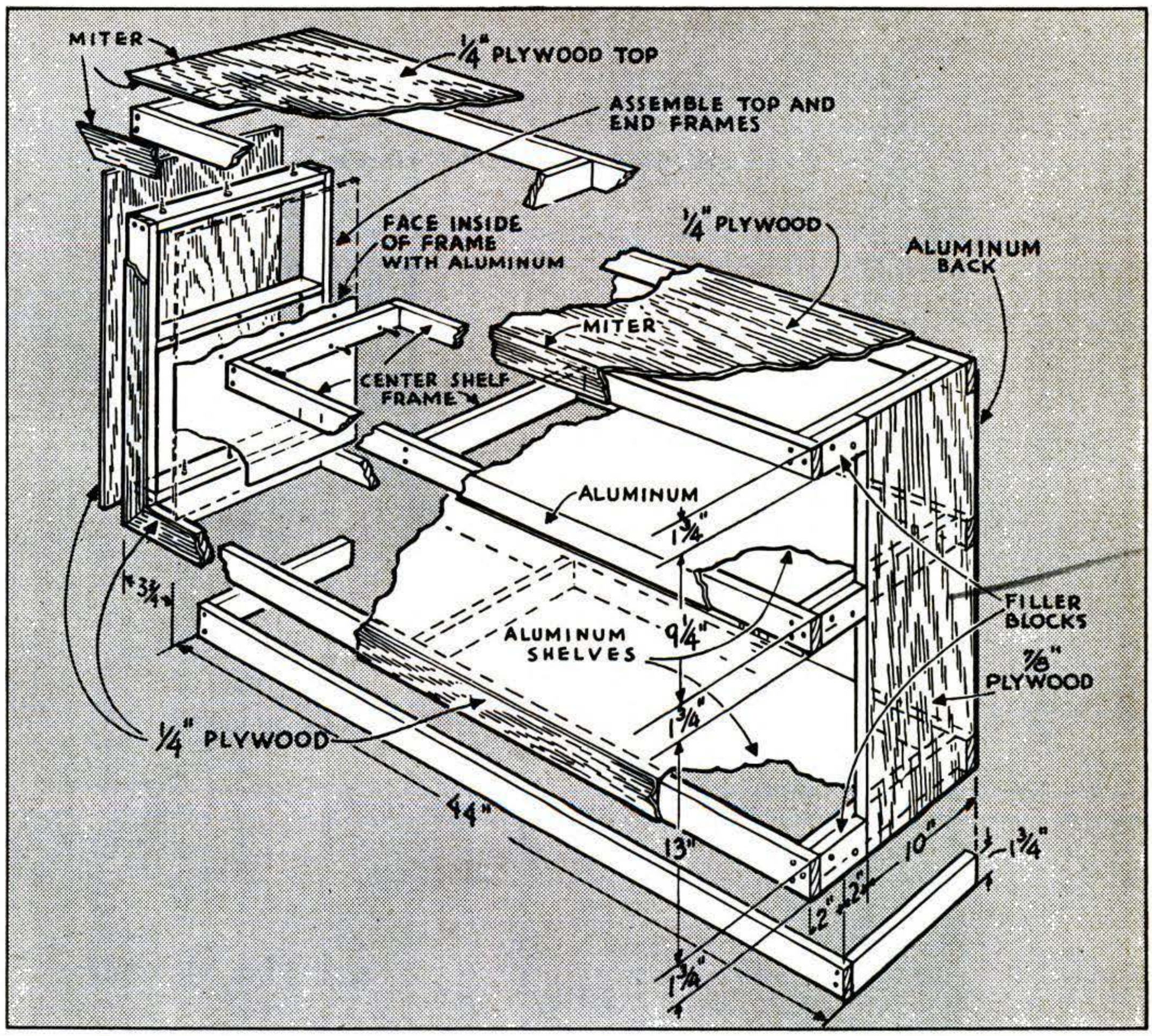

Panel edges must be trued for neat butt joints; putty and paint conceal small imperfections.

frame, cover the inner face of the larger side with aluminum. Attach the shelf frame over this, and brace the entire unit to keep it perfectly square while the back and shelf sheets are added.

Secure the aluminum panels with small flathead wood screws countersunk in the metal. Although the sheet is thin, the depth of the countersink is easily controlled, and very little metal is needed to engage the screwhead. Use a twist drill just larger than the screwhead, and cover the heads with plastic putty or composition wood. This may be knifed in and sanded smooth when dry. A hard wood putty will effectively seal the panel-to-panel and aluminum-to-frame joints; a coat of paint over all gives a flawless surface.

Two units are pictured on the facing page; the drawing above shows the construction of the left-hand one, which is identical with its right-side counterpart except that the ends are reversed. Dimensions were dictated by available material and the desire to house record albums in the lower shelf. The dimensions of your units may easily be altered to suit other specifications.

Walnut-veneered ¼" plywood is used for top and outside panels. These pieces are put in place last and held only by glue. Joints between the pieces are sealed with wood putty that has first been colored to match the veneer. The units illustrated were given a coat of shellac, and then varnished and pumiced to a fine satin finish. Interiors were painted gray-green to match the appointments of the room in which the cases are used. Since the footboards are almost totally hidden in shadow, they were painted flat black but not otherwise finished.

The units can be used singly or end-to-end. Since the partially open side, if properly finished, will be as attractive as the enclosed one, they may be faced either way.

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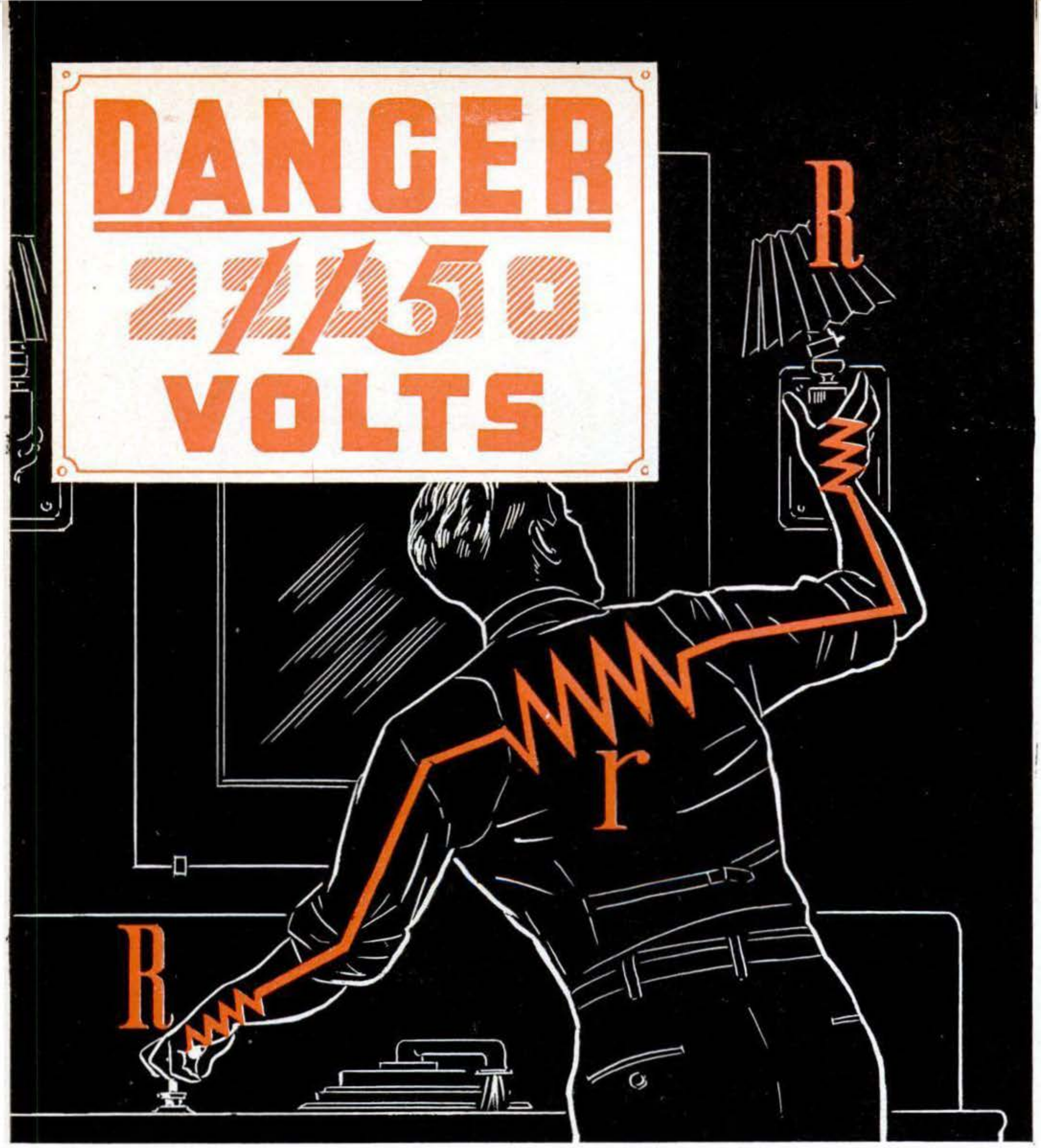

Portrait of a man about to get a shock. Probably it won't kill him, but he'll remember it.

What you should know about electric shock, when it is most dangerous, and how to keep off the receiving end.

IT IS not only possible to electrocute yourself but fairly easy. You don't have to hunt up a third rail, high-tension line, or other potent killer; the job can readily be done at home with common house current. Avoiding an untimely end is also fairly easy, though it does call for a little electrical knowledge and a supply of common sense.

Electrical shock is widely supposed to be a freakish, unpredictable matter. High voltages are generally believed dangerous and low ones harmless. (Actually, touching an auto sparkplug will give you a 12,000-volt kick, and will be harmless though uncomfortable; shorting a 6-volt storage battery with a finger ring can send you to the hospital with severe burns.) In your own experience you may have noticed how sometimes a 115-volt shock will be a mild tingle and at others a sharp jolt.

In reality, there's nothing freakish about shock. When part of a human body becomes part of a circuit, the results are almost as predictable as the light that comes on when you snap a switch. Voltage is only one factor. Some of the others are the nature of the current, (whether DC or AC, and if the latter, at what frequency), path

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through the body, physical condition, skin resistance, amount of current, and its duration. If you know what keeps a trivial tingle from being a dangerous shock, you'll be taking a big step toward electrical safety.

Another big step comes when you remember that the "least expected soonest happens." The person who began work on a refrigerator that was not running at the time, and who was injured when the thermostat clicked it on, is a typical example of common-sense failure. The youngster who was killed when his control-line model plane zoomed into a power line is another. With electricity, protection lies in anticipating the unexpected.

For a typical shock circuit, observe the man most unwisely reaching toward a defective fixture in the drawing at the left. When his right hand touches the "hot" (ungrounded) terminal on the socket, he'll get a memorable jolt. Probably he won't be killed, though a combination of wet hands and a bad heart might finish him. Circuitwise, his body is going to serve as a conductor between the hot lead and the faucet, which is an electrical ground. If his left hand doesn't touch the faucet, and if a dry bath mat insulates him from the ground, he may get no shock at all. If his body is ungrounded but his right hand touches both hot and grounded socket parts, he'll feel a sharp shock across the fingers.

It is current that kills. Voltage is important only to the extent that higher voltages can push through higher currents. An astonishingly slight current can be fatal. One investigator, a consulting engineer named Alfred W. Barber, reports that with 60-cycle 115-volt AC, about .075 amp. (75 ma.) is the dividing line between safe and dangerous currents. Others set the amount as low as 50 ma. Even tinier currents produce severe discomfort; and about 8 ma. is believed to be the most that can be tolerated for a considerable period of time. Incidentally, 75 ma. is about the current that flows through a small 7-watt night light.

The most dangerous electricity is AC of from 50 to 150 cycles. DC is believed to be slightly less lethal than AC. The amount of current that can be tolerated goes up with frequency; at a million cycles a human body can safely pass 3,000 ma.

Fortunately, a body isn't a very good conductor. Consider once more the man reaching for the defective socket, whose body may be thought of as three different re-

Shock Hazards in the Home

The chief electrical dangers in the home lie in a combination of defective equipment and unwise use. If the "hot" side of the 115-volt line should touch the metal housing of the hair curler, washer, lamp, or heater, a circuit to ground via the user could exist in these cases. Very severe shock or even death might result. Note that there is no warning: each appliance would still work. For safety, test all equipment periodically in both possible plug positions for internal grounds; and caution all members of the household to be wary of electricity near water.

Don't use a hair curler near water

Ground a washer that has casters

Don't touch a light and a radiator

Keep electricity away from the tub

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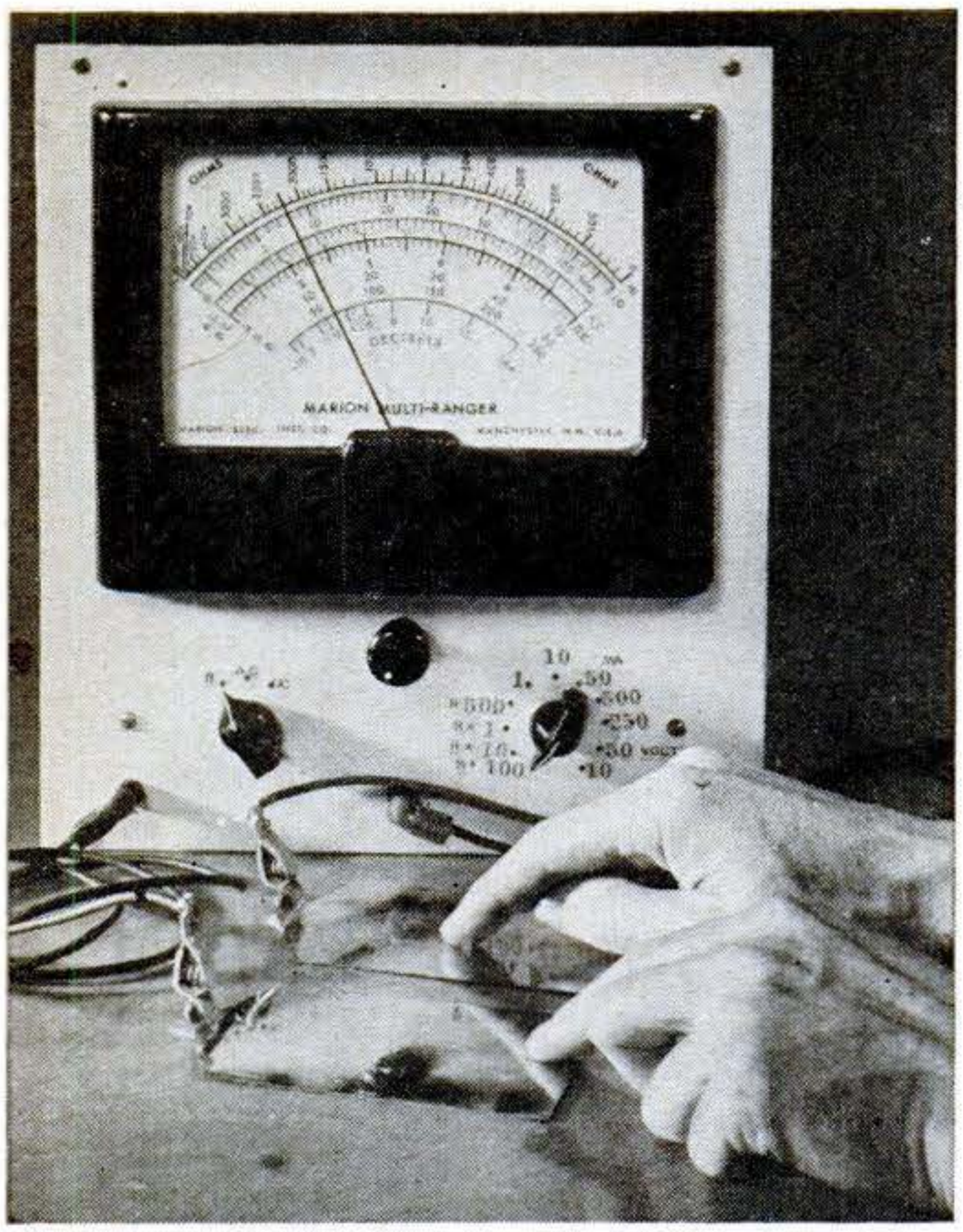
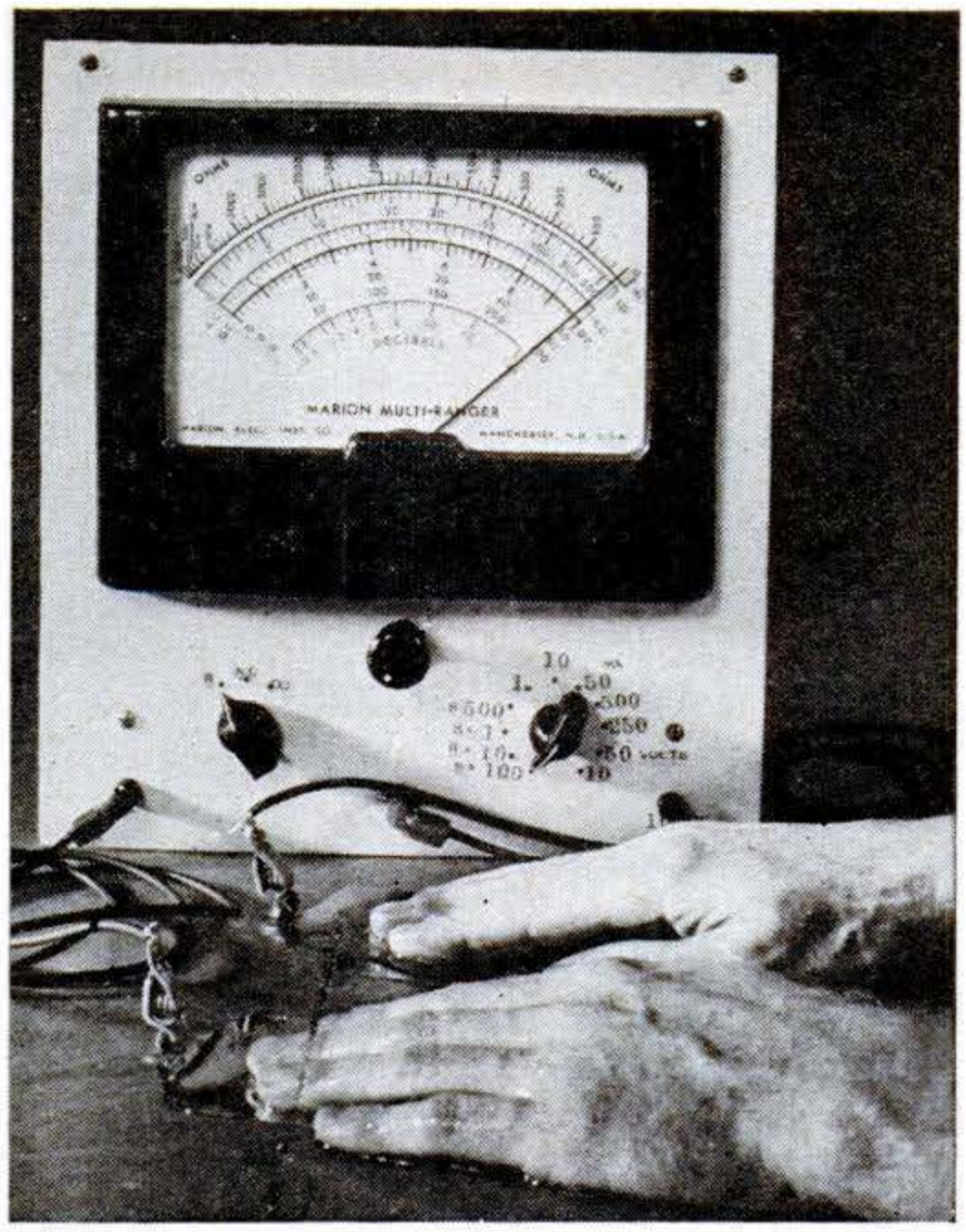


Dry fingers and light pressure give a total resistance through the body of 250,000 ohms.



Wet hands and a larger area drop the resistance down to a dangerously few thousand ohms.

sistances connected in series. Internal resistance, *r*, is comparatively low, probably 1,000 to 5,000 ohms. Skin resistance, *R*, is a factor at the two points where the circuit is completed, and is widely variable. If his right hand is entirely dry and if a finger lightly brushes the hot contact, *R* may here be as high as 250,000 ohms. But if his left hand is firmly grasping the wet faucet, *R* may here drop to a hundredth of that value.

Skin resistance is what makes it possible for us to live with electricity. Obviously we should guard it carefully, for when it goes, we may too. Moisture, pressure, area, and duration of current (*R* has a tendency to break down under current flow), are all important factors, but of these moisture is by far the most important.

Often the difference between a dry and a humid day is the difference between a mild tingle and a sharp shock. Even slight perspiration on the hands causes a huge drop in *R*. Photographers in particular should be careful, since the moisture and salts of photo solutions cut down *R* sharply. And everyone should be on guard against electrical hazards in those places—bathroom, kitchen, and laundry—where wet hands are to be expected.

In the bathroom, fixtures should be porcelain rather than metal. Sockets should be connected so that the ground (white) lead runs to the shell contact, not the center one. A bead chain from an overhead light should have an insulating link in it. Radios, heaters, curling irons, and fans (if they *must* be used in the bathroom) should be frequently checked with a neon tester to make sure their metal housings do not show a voltage to ground in either of the two possible plug positions. And everyone in the household should be cautioned *never* to touch anything electrical with even slightly damp hands.

In the kitchen, heavy-current appliances like irons and toasters should be checked periodically, with particular attention to the insulation on cords and plugs. (An iron draws more than one horsepower of energy, and merits the care allotted any piece of equipment of that power.)

In the laundry, a ground wire should be attached to the washing machine if it is of the nonautomatic type. This is important because an insulation defect allowing the body of the machine to become electrically hot may readily occur. This would not necessarily blow a fuse, for fiber casters might insulate it from the wet floor, but anyone touching the machine with one hand and the set-tub faucet with the other could get a dangerous shock. There'd be no warn-

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ing; the washer could still function with that insulation defect. The safety factor of a ground wire—which can be simply a lead running from any bare part of the washer to the nearest water pipe—lies in the fact that it will cause such a defect to blow a fuse.

In the workshop and darkroom, similar equipment check-ups are wise. Machine tools on wooden benches or stands should be grounded, since damp concrete floors, plus the nails in your shoe heels, can provide a ready path to ground. A wooden duckboard flooring is desirable by the fuse box, and also by the radio and electrical bench. In the darkroom, light switches and enlarger controls should be maintained in apple-pie order.

So much for equipment. Procedure, or what you habitually do with the equipment, is equally vital. It goes almost without saying that whenever possible you should work only on dead circuits or appliances. Most of us have occasionally disregarded this rule; and some do it habitually, affecting an ostentatious contempt for 115-volt juice. The character who pokes a finger into a socket to see "iffen the soup is there," like the fellow who kindles a fire with gasoline, is simply exercising his God-given right to be stupid. But most of us have managed to outgrow such bravado behavior.

Knowing when a circuit or appliance is dead isn't always easy. A drill press operated by a single-pole switch, or a house circuit deactivated by the removal of one fuse, is not necessarily dead. In the first case, the plug may be in such a position that the switch simply opens the ground wire; in the second, the remaining fuse may keep the hot lead hot. Make it a fixed habit always to unplug an appliance before working on it, and always remove *both* fuses from a 115-volt circuit before you touch it.

In radio work in particular, it's sometimes necessary to adjust or test live equipment. Practically all radio transformers deliver 300 volts; twice this voltage is common; and some equipment, such as television sets and oscilloscopes, uses 1,500 volts or better. Aside from keeping hands absolutely dry and standing on wooden floorboards, certain other precautions are wise:

1. Don't work with the power on except when you must.

2. Keep one hand in your pocket when working around the high stuff. This old stunt has two virtues. It keeps you from touching the chassis for balance or for resistance against pull or pressure from the other hand (an almost involuntary act). It also means that any shock you do get will be across the fingers, not dangerously through the chest—always provided you're standing on an insulating floor.

3. Don't roll up your sleeves. Many shocks are received through the forearm.

4. Train yourself to plan in advance just precisely what to do with the test prod or fiber wand. The habit of thinking with your hands invites trouble.

5. Don't forget that condensers may hold a charge long after power is disconnected. Short every large-capacity condenser each time power is cut.

6. On experimental high-voltage work, insert if possible a 1-meg. resistor in series with the load. This may not keep you from getting a sharp jolt, but the resultant voltage drop on a shock circuit may save your life.

7. Be wary. "Automatic" protective devices, like red telltales that shine when the high stuff is flowing, or interlock switches that cut off power when a panel is opened, are both desirable precautions, but reliance on them isn't enough. Security comes from a state of mind, not an interlock switch. END

Basic Rules for Electrical Safety

1. Don't discount 115-volt current. Mishandled, it can cause fire, injury, or death.

2. Don't draw more than 15 amp. from a branch circuit, and don't fuse such a circuit for more than 15 amp.

3. Regularly inspect all fixtures and appliances for defective insulation.

4. Pay particular attention to electric equipment in the bathroom, kitchen, and laundry. Make sure the housing on such equipment does not show a voltage over ground. Add separate ground wires to nonautomatic washers and power tools.

5. Use wooden flooring near the fuse box and electrical bench.

6. Always unplug appliances before servicing, and remove both fuses before working on a branch circuit.

7. Exercise extreme care with all equipment having high-voltage transformers. This includes radios, television sets, electric-fence devices, and neon signs.

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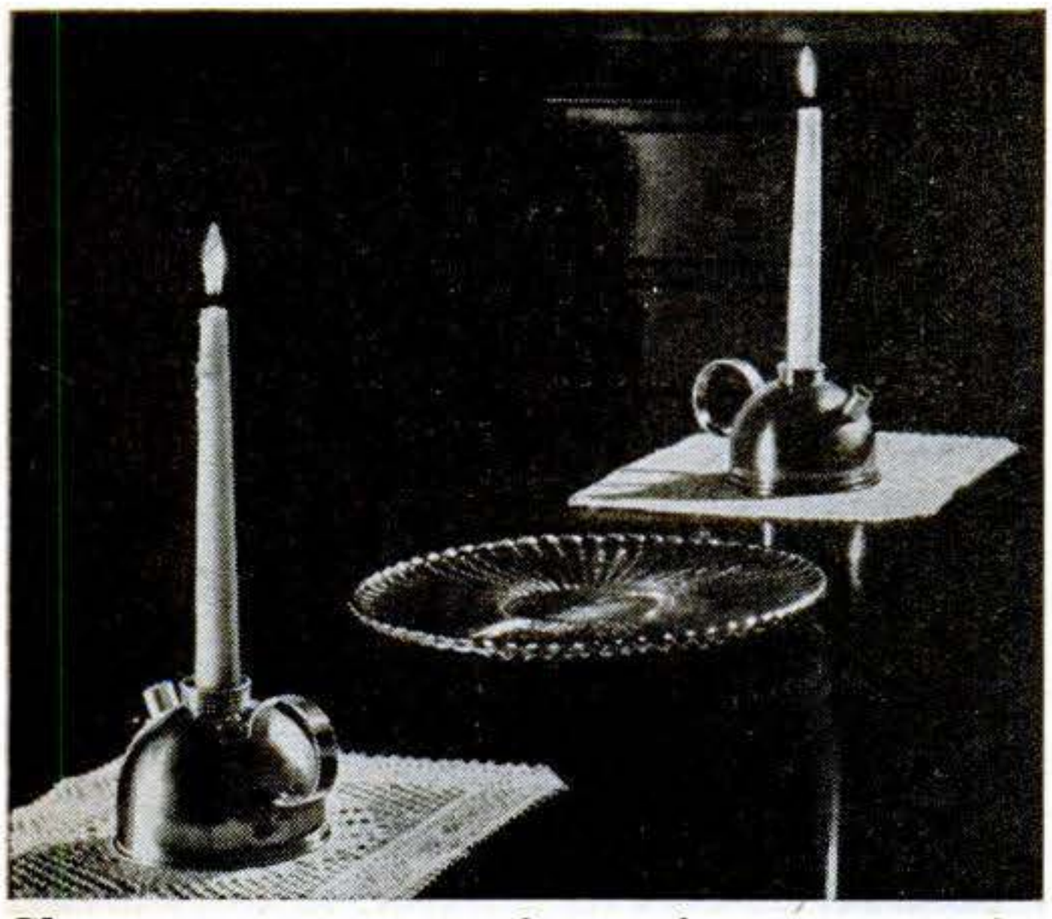
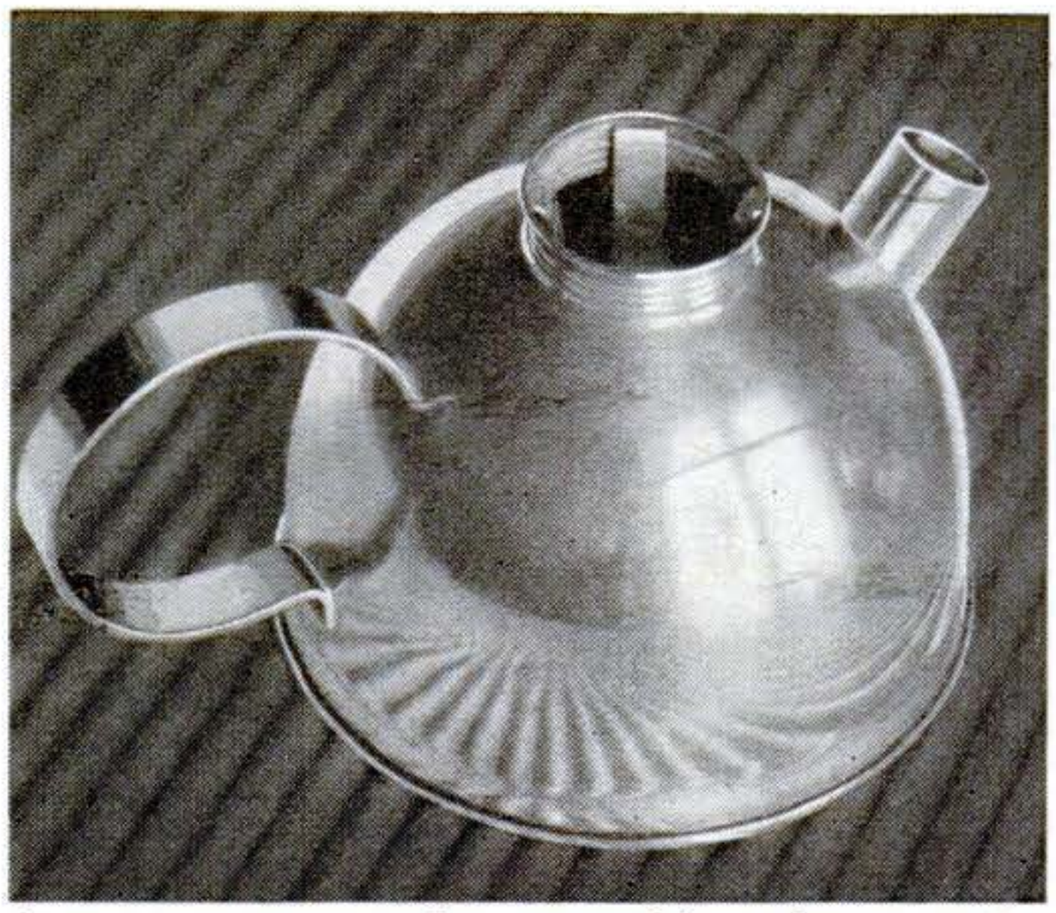


Gleaming copper is the perfect material for these candlesticks. They look best used in pairs.



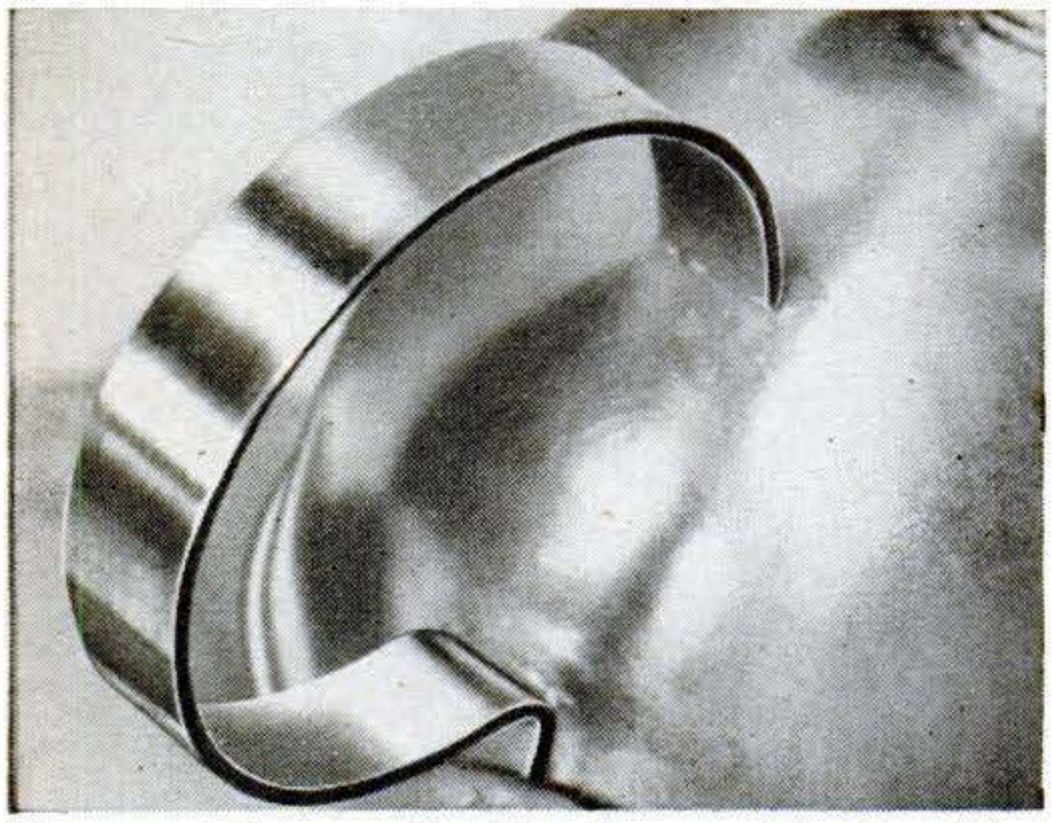
A one-pint can makes a good base for even the taller candles, since it will not tip over readily.

Oil Cans Make Teakettle Candlesticks

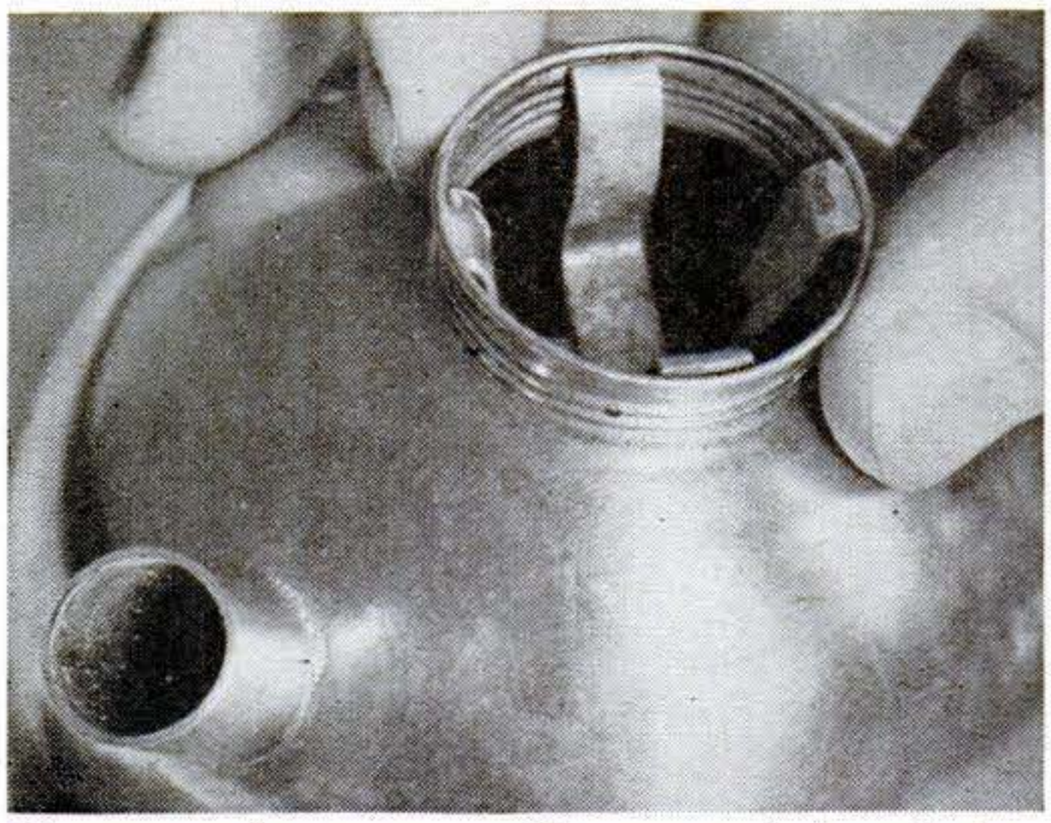
RESEMBLING miniature copper teakettles, these unusual candlesticks are made from a pair of lowly oil cans, available for a few cents apiece at the hardware store. Besides the copper-plated, snap-bottom oil cans, you will need only some ½″ O.D. copper tubing and a few scraps of sheet copper.

Hacksaw a 4″ length of the tubing in half, making the cut at a 30-deg. angle. This will give you the two spouts. Shape the cut ends with a file until each spout fits evenly against the curved side of the can. Tin the ends of the spouts and solder them in place, taking pains not to use any more solder than necessary. For the handle cut a ½″ by 6″ piece of fairly heavy sheet copper, bend it around a pipe or wood form about 1½″ in diameter, and bend back little soldering tabs at one or both ends of each handle. Tin the tabs and solder in place directly opposite the spouts.

The candle cups are simply a crossed pair of ½″ by 3″ copper strips. Mark the strips 1″ from each end, bend at the marks to make a square U-shape, and then bend out the upper ends so they will bear against the neck of the can. Tin these ends and solder in place. Clean up each can with emery cloth or steel wool, being careful not to injure the plating. If you want a bright coppery finish, buff the candlesticks and use a light coating of lacquer or wax to retard tarnishing.—J. HARLEY HOSACK.



Use a minimum of solder for attaching handles. A torch makes for neater joints than an iron.



Clearance between candle cup and threads lets wax drip inside, making a saucer unnecessary.

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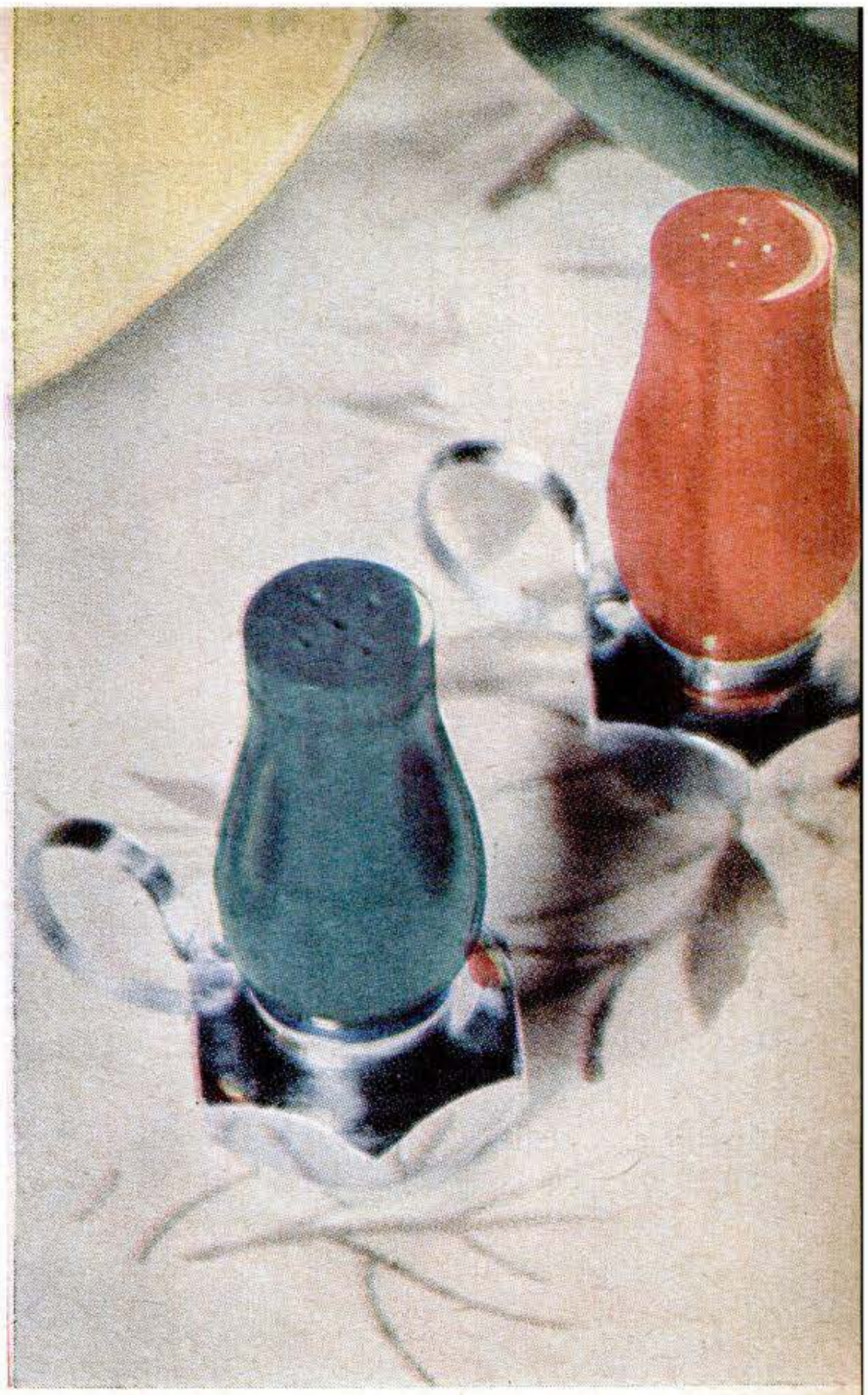
Bright Plastic "Lamps" Serve Salt and Pepper

FASHIONED in the form of miniature oil lamps, these salt and pepper shakers would grace any table. The chimneys are turned from colored plastic and the bases from aluminum. Making the set is an interesting lathe project—simple but requiring several careful fits.

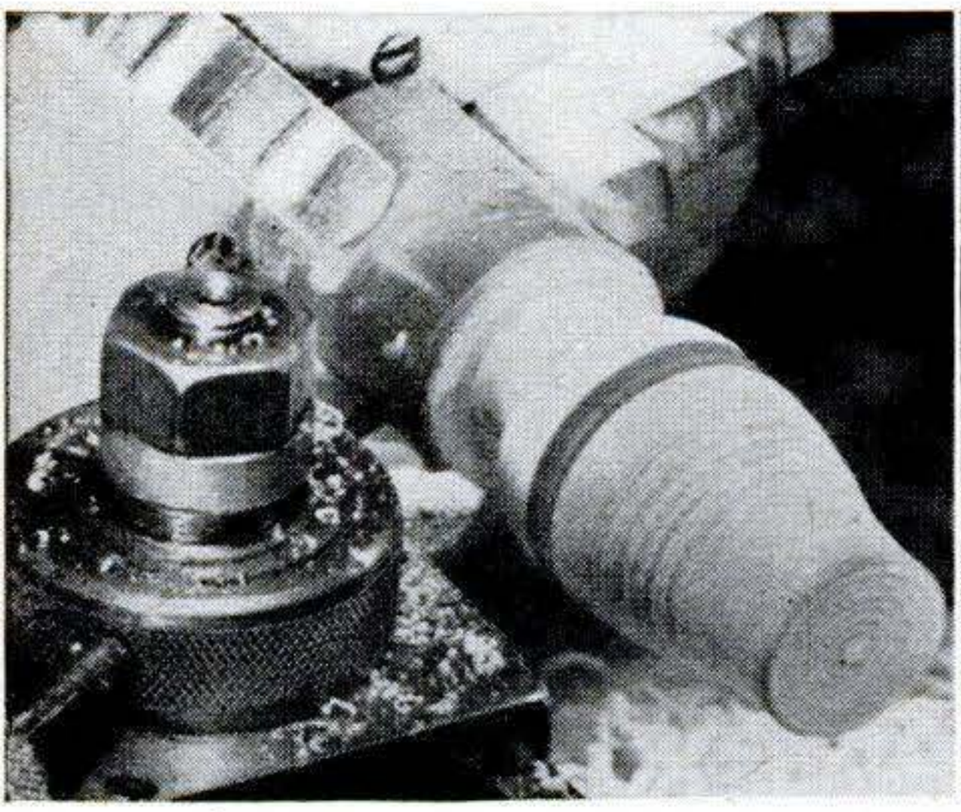
Turn the bases from 1⅜" aluminum-alloy hex stock. Bring the curves smooth with a file and abrasive papers, and draw-file the flats after locking the spindle in successive positions with the index pin or back gear. Polish the work by revolving the lathe at its highest speed and using plenty of oil with fine abrasive paper.

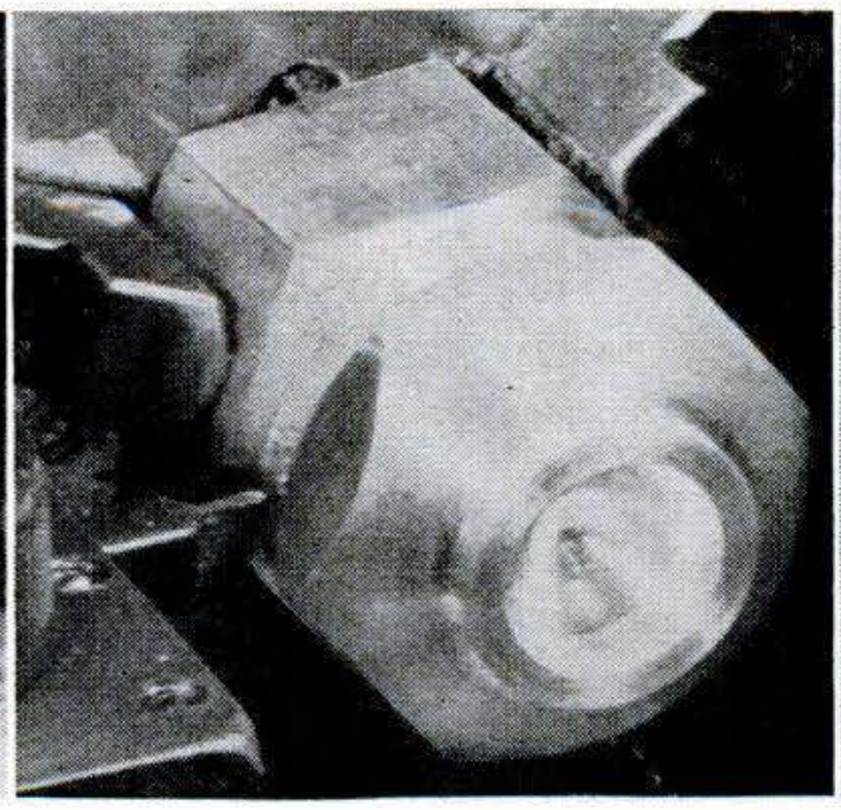
Drill the ⅝" hole for the chimney to a depth of ¼" and drill and tap 2-56 holes in each base. When this has been done, buff the work to a high polish on a rag wheel, using tripoli followed by a clean wheel. Cut the 3/16" by 2⅞" handle strips from 18- or 20-gauge aluminum, file the edges smooth, drill No. 46 holes in the ends, bend carefully to shape, and screw to the base. Then with a hand grinder or file work down the screw heads until they are thin disks.

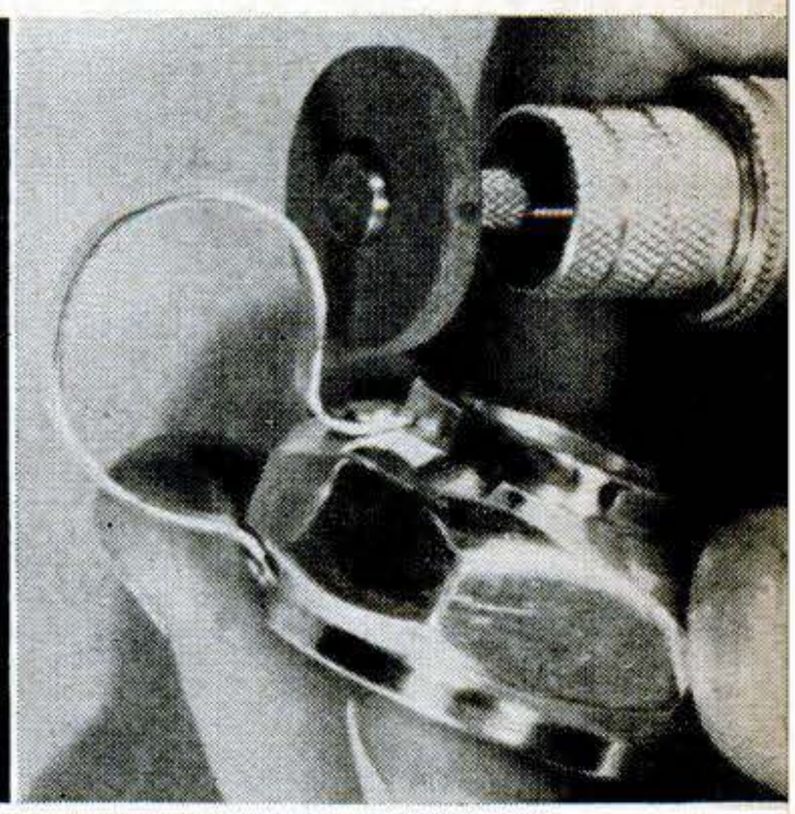
The chimneys can be made of any machinable plastic, but one of the cast resins probably will be best. Chuck a piece of 1⅛" stock and face off the end. Using a cut-off tool, turn the ¼" by ⅝" stub, calipering the diameter slightly over size for a snug push fit in the base. After turning the rest of the chimney, drill the ½" center hole to a depth of about 1¾". Give the piece its final shape and smooth surface by running it at high



Contrasting colors help distinguish the salt from the pepper. Use the red for the pepper.







Turn the chimney stub, left, for a tight fit in the base. A parting tool is used, center, to cut off a finished base. Right, the heads of the handle screws are ground to thin disks.

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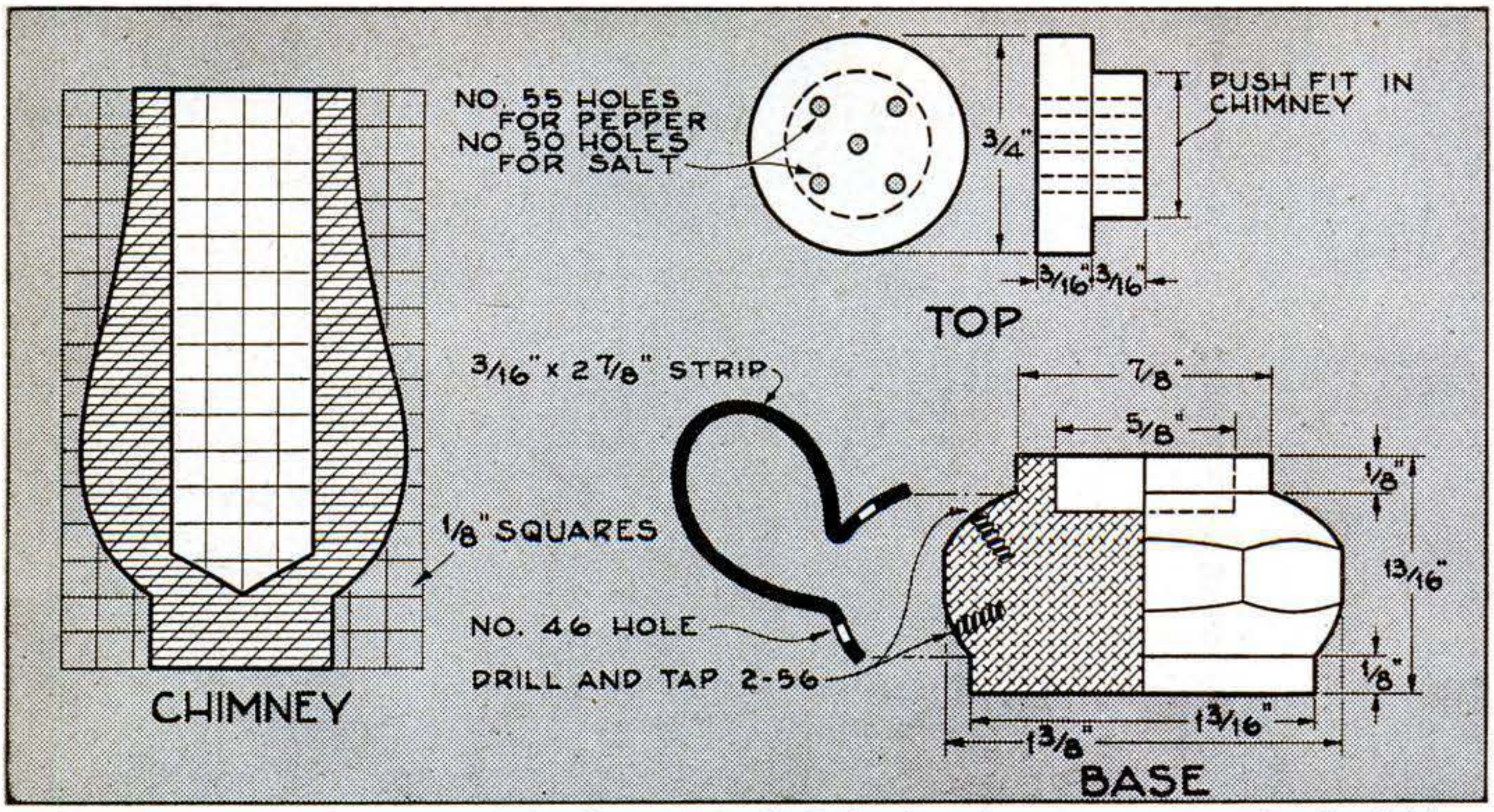
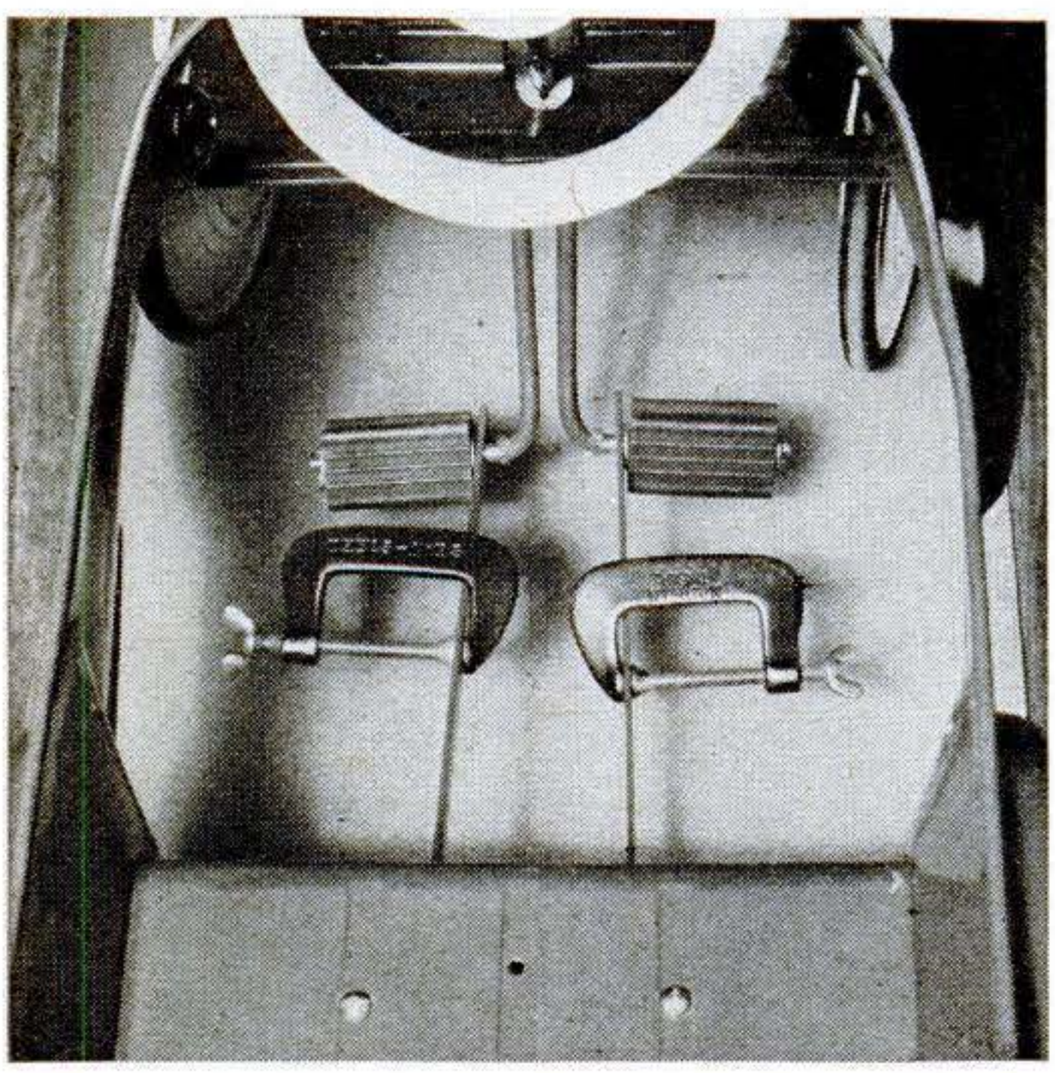


After turning the base from 1⅜" hex stock, drill the ⅝" chimney seat to a depth of ¼".

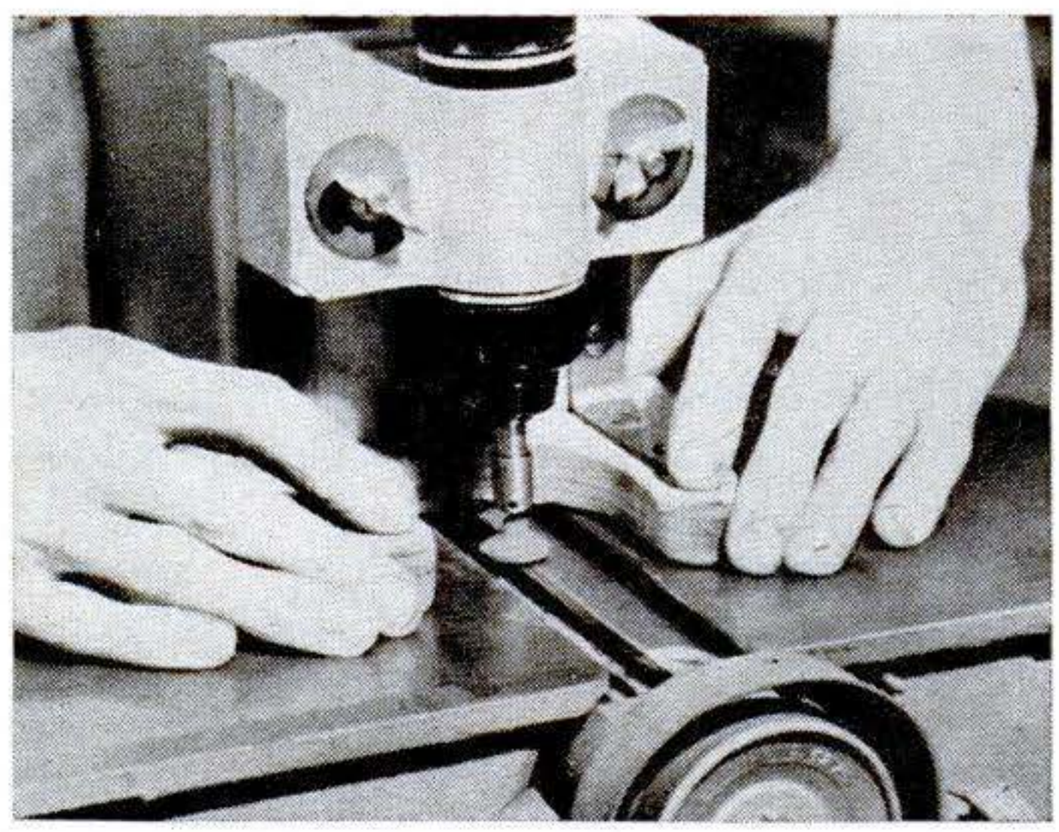
speed and using increasingly finer grades of abrasive papers with plenty of oil.

Turn the filler caps from the same plastic, leaving the shoulders just large enough for a push fit in the shakers. Drill five No. 55 holes in the pepper top and five No. 50 holes in the one for salt. Polish all the plastic parts to a brilliant finish, using a buffing compound and finally a clean cloth wheel with no compound.—Bill Luther.



Clamp Pedals Are Adjustable

There's no need to worry if Junior can't reach the pedals of his new car, for a pair of 2½" C-clamps will provide an excellent set of adjustable pedals. As the child's legs grow, the clamps can be moved forward. Mount them as shown above and turn them up tight with a pair of pliers each time they are changed.—Alvin J. Brault.



Jointer Sharpened with a Jig

By clamping a hand grinder in the jig shown above, you can grind your jointer knives without removing them. A cup-wheel stone chucked in the power tool is moved along the edge of the knife.

Level the ends of the jointer table and adjust the cutter head to bring the edge of one of the knives level with the plane of the table. Use a straightedge for this so that the correct rake angle will be maintained. Then lock the knife by clamping the V-belt to the guard.—Jack Albrecht.

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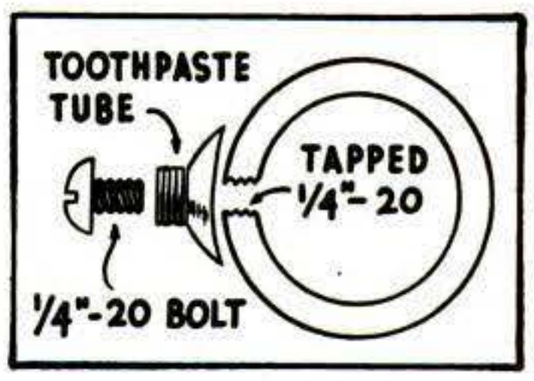
What's Your Ingenuity Quotient?

It Nearly Floored Me when I was faced with the job of painting a couple of large floors. After doing the first on all fours, it was a matter of giving my calloused knees a rest or risking double housemaid's knee. So I got a new push broom and a wide shallow pan and set to work. Sweeping the paint on didn't require any more than would have been used the regular way, and it produced a neater and better job at the same time that it cut down on time, leg strain, and backaches.—ROBERT F. ABELL.

Pinhole Problem. One of my truck tires would fall slowly from full to half pressure, and stay that way. With the tube out, I couldn't inflate it enough to show leakage even under water. So I removed the valve, poured in a little ink, and put in air. When I next removed the tube, an ink mark showed the pinhole leak.—GEORGE ENGSTROM.

Lead Licks Leak. When a water pipe started dripping one night, I turned off the pressure and tapped the hole ¼"-20. Using the top of a toothpaste tube as a gasket, I drove in a short bolt to squeeze the lead tightly around the opening. —J. A. RICHARDS.



I Hear Lefty. Being deaf in my right ear, I can't hear sounds that come only from that side. For a long time that meant I couldn't talk to passengers while I was driving a car unless they happened to be standing on the runningboard. Since that didn't seem entirely practical, I put ingenuity and my good ear to work. About 8′ of old vacuum cleaner hose and two discarded auto-horn trumpets did the trick. One end of the hose leads to the horn fastened near my left ear; my passenger holds the other end. When I'm alone, I place it near the auto radio speaker and listen to my favorite programs in comfort.—FRED C. DALEY.

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

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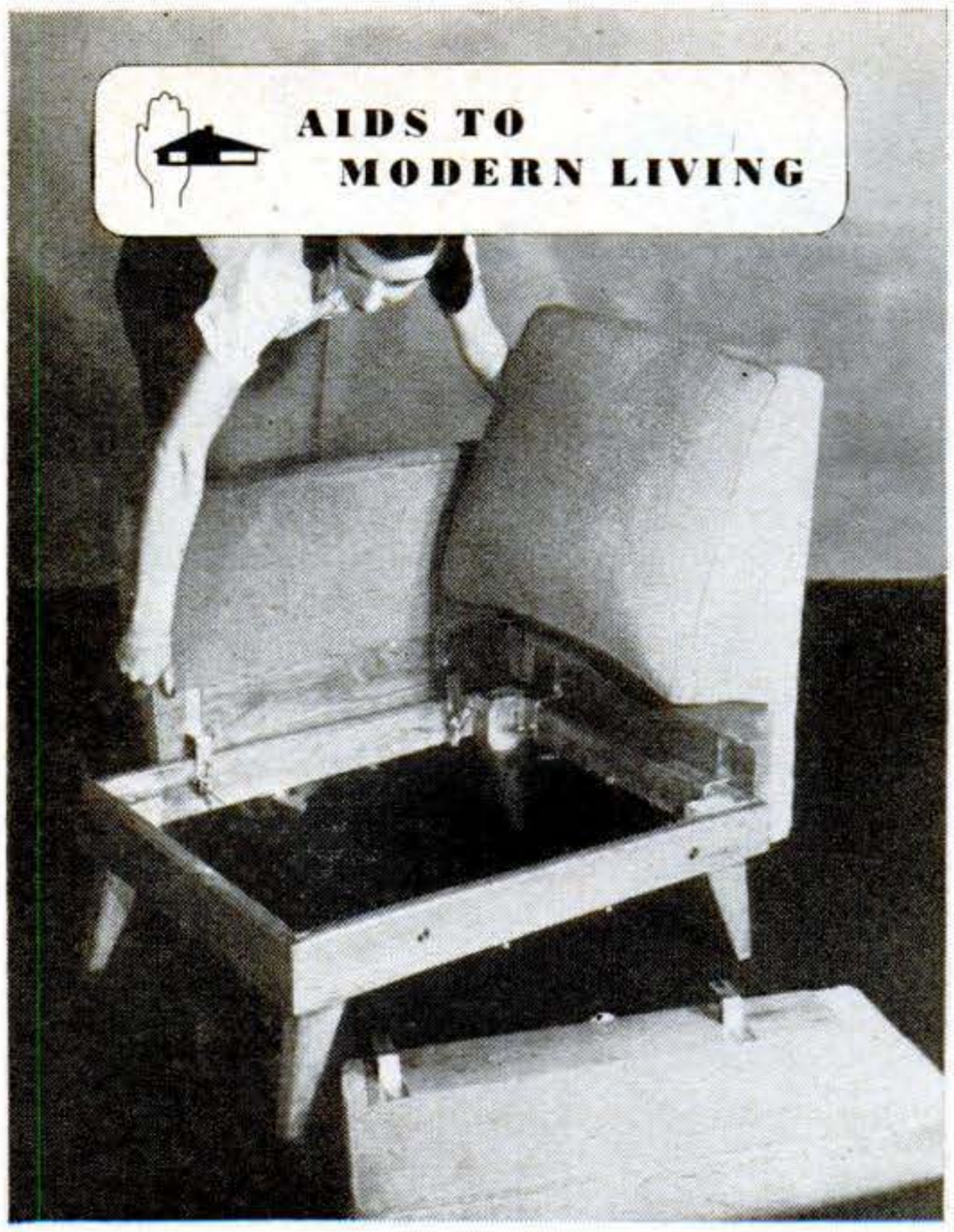
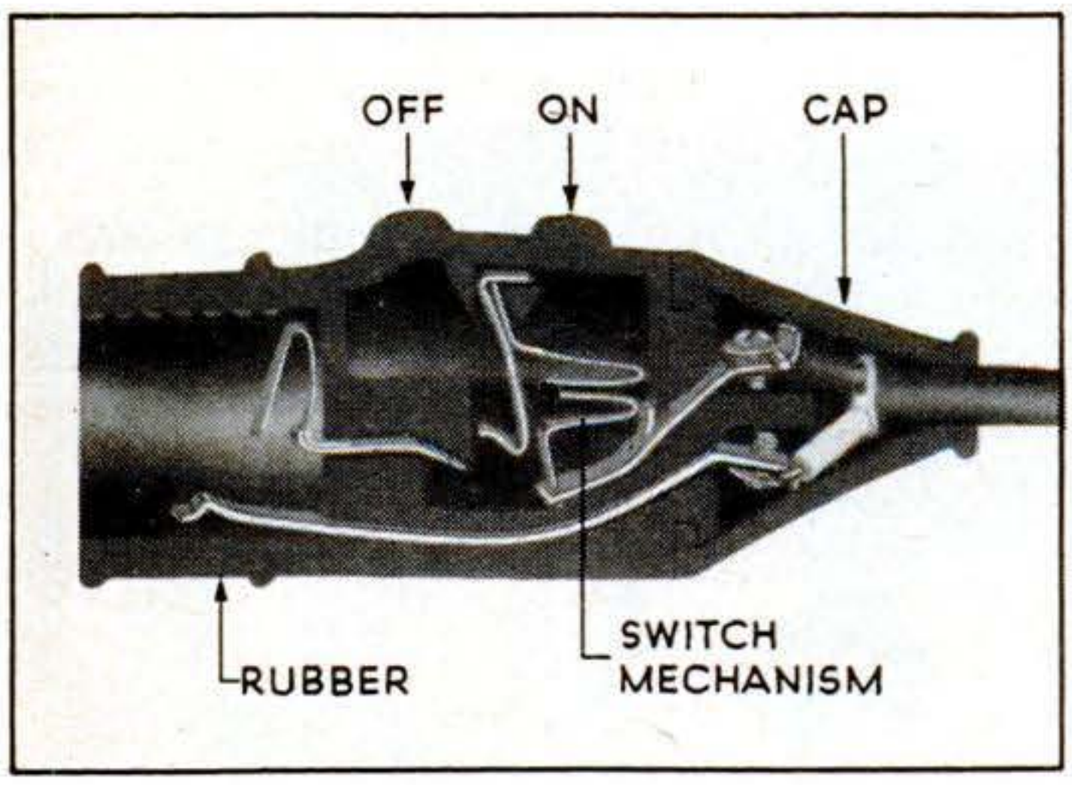
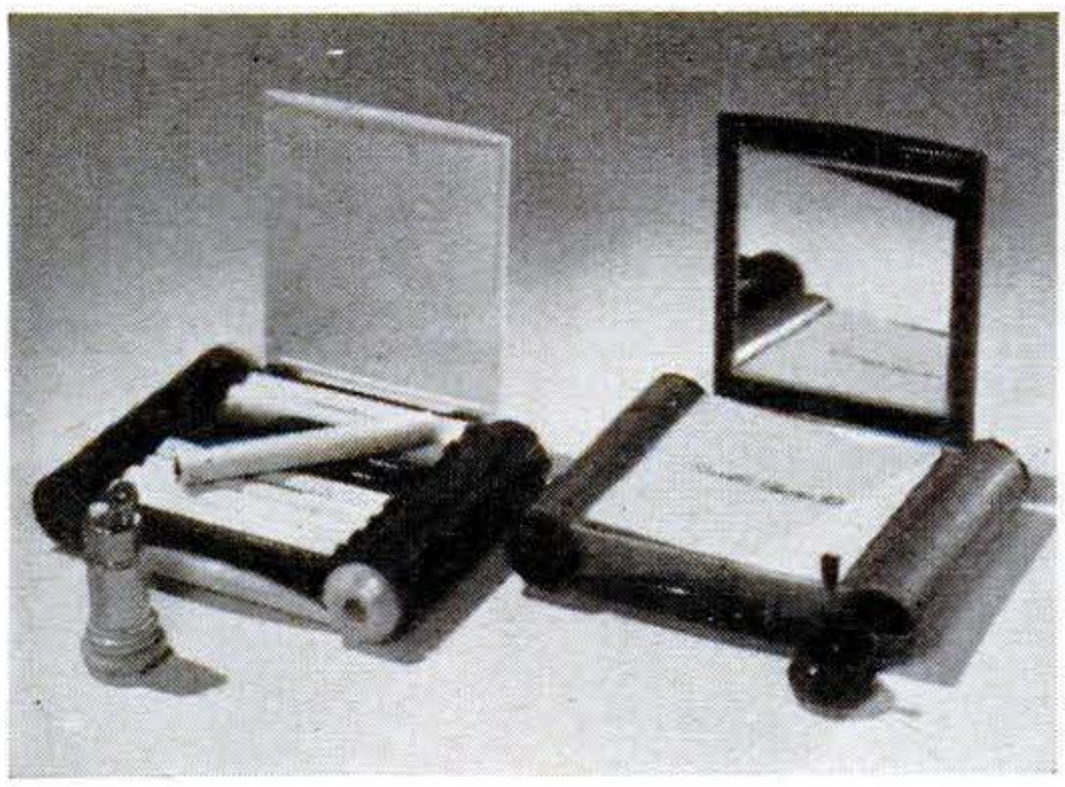


Assemble Your Furniture. Arms, backs, seats, and chassis of this new line of furniture may be bought separately and assembled into whatever you need—an ottoman, chair, love seat, sofa, studio couch, or chaise longue. Screws and lock mechanisms on the oak chassis facilitate installing or taking off the back and arms. Since both the chassis and seat have a pitch of 1″, the seat slants backward when used in a chair or sofa. But if you want a studio couch, a level surface is obtained merely by turning the seats end for end. Manufactured by Lewittes & Sons, of New York City, the furniture is offered in a choice of three grades of fabrics and various colors.



Socket Sealed in Rubber. A switch socket made by the Adams Mfg. Co., of Davenport, Iowa, has a rubber body with a sealed switch mechanism, which is operated by flexing the knobbed part of the case. Since there is no threaded metal ferrule, a bulb is pressed rather than screwed into the socket. Likewise, the cap is worked onto the body of the socket after the wires have been connected to the terminals.



Kit Has Five Uses. A plastic kit placed on the market by Revell of Hollywood represents an effort to organize a woman's purse. It includes a compact, cigarette case, lighter, lipstick brush, and a small flashlight. The flashlight is located in a cylinder at one end, the lighter and brush in a cylinder at the other end. Measuring approximately 3½″ by 4½″, the kit sells for about $5. It is called a "Glamor Kit."

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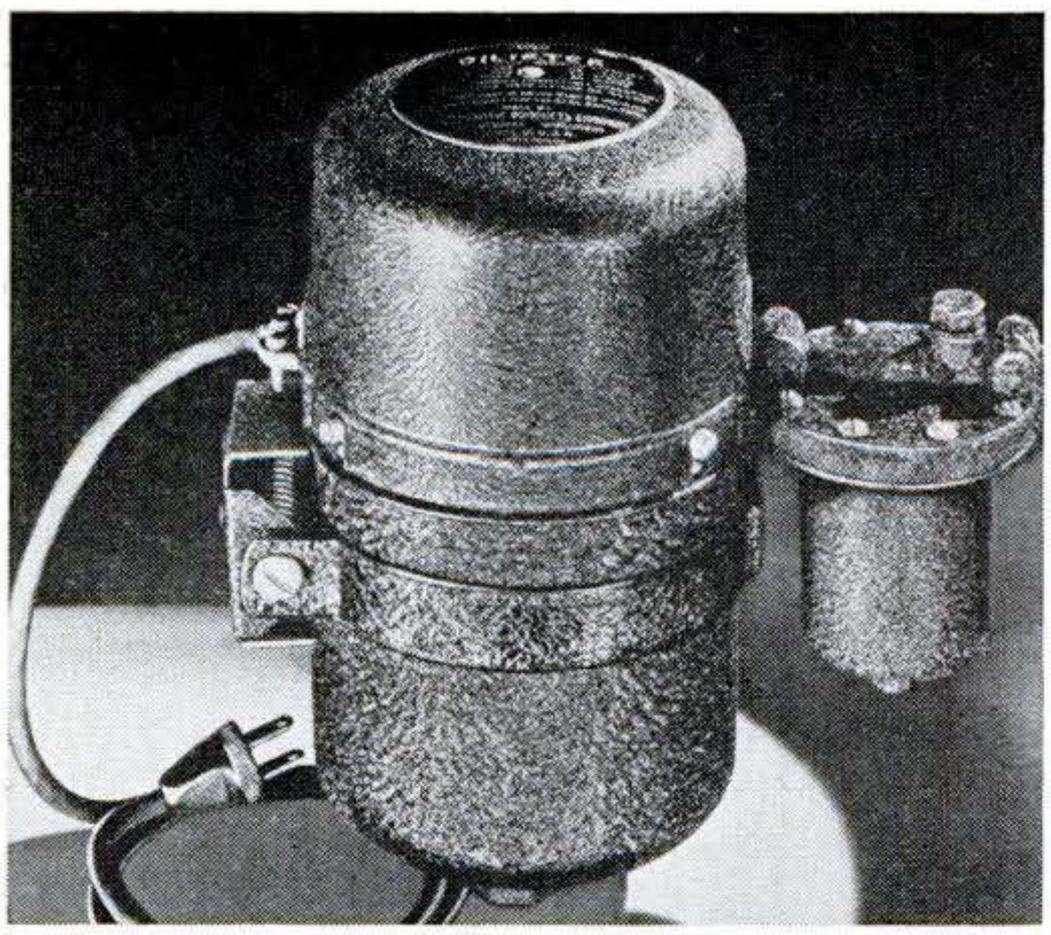
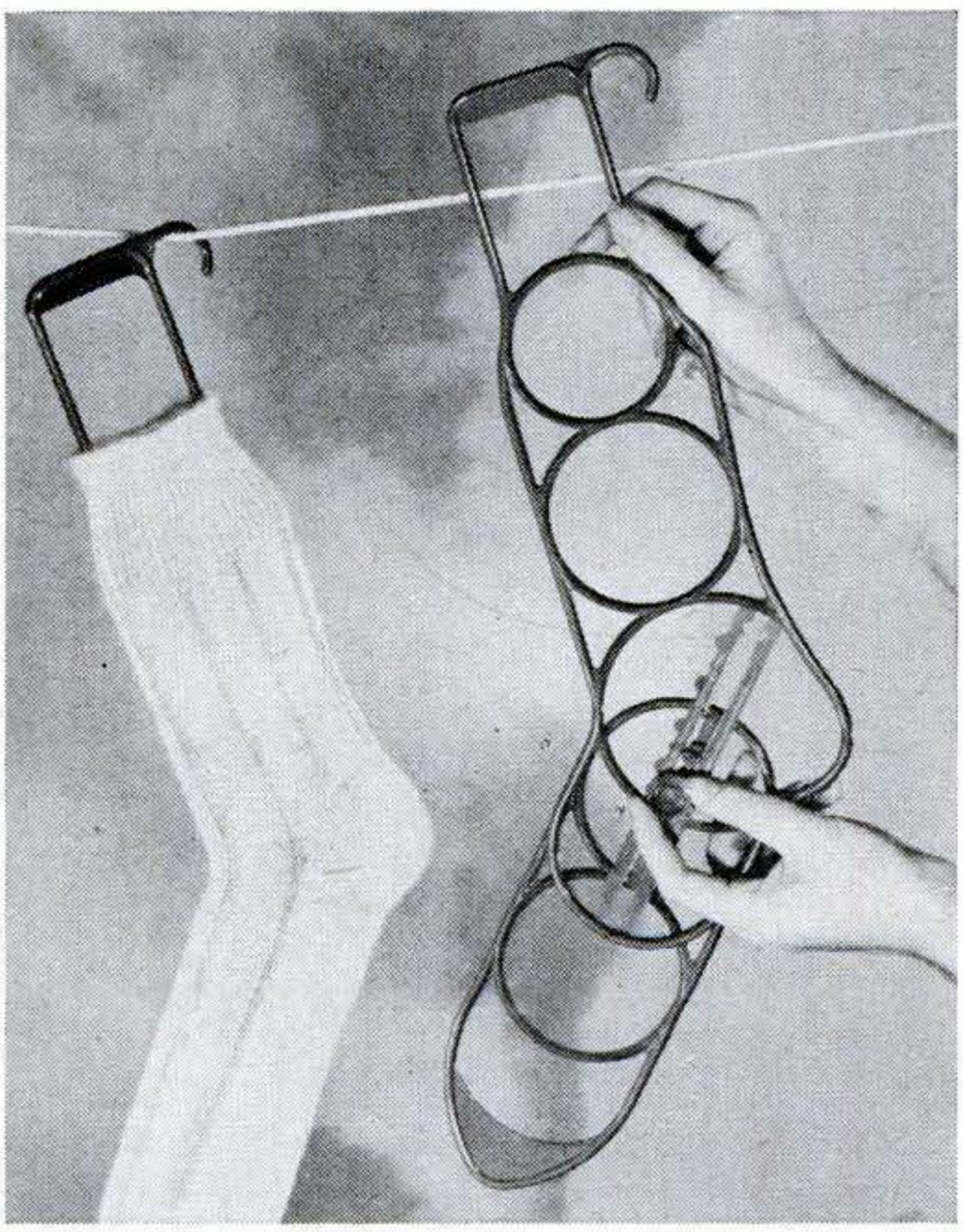
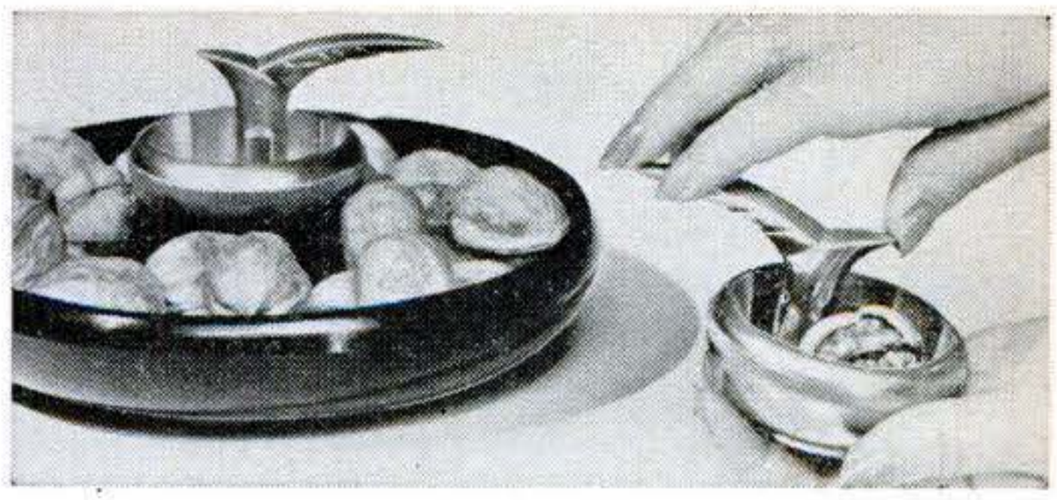


Eliminates Oil Carrying. Designed for use with any kerosene or oil-burning heater, furnace, or range, this electric device will pump oil from a storage tank to a location as much as 25′ higher, ending the chore of carrying fuel by hand. The pump has a capacity of 1¼ gallons an hour. Automatic Products, Milwaukee, makes it.

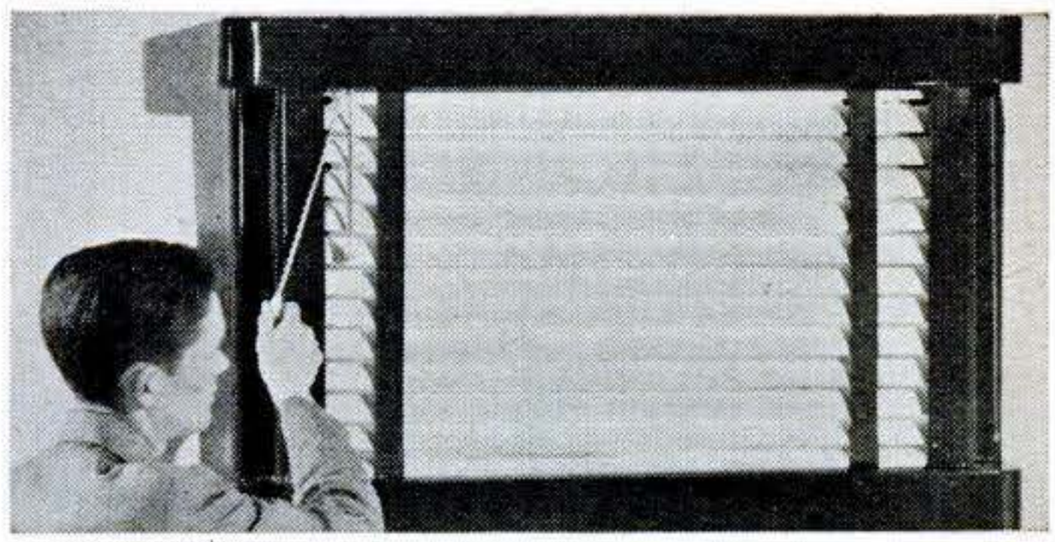


Sock Form Is Adjustable. Made of plastic, these wool-sock stretchers take any size from 9 to 13. Thus several members of the family can use them. To prevent leg shrinkage, the tops may be clipped to either the upper crosspiece or the leg-section reinforcement. The stretchers are made by Craft Industries, Buffalo, N. Y.



Nuts Squeezed Open. A twist of the wrist is all that is needed to shell nuts with a nutcracker introduced by the Potter-Ware Company, Newark, N. J. Made of aluminum alloy, it consists of a four-sided spindle set in a bowl that is grooved around the inside. The spindle rotates like a shaft, but is eccentric on its base. Turning it causes the square-sided post to squeeze the shell, cracking it without crushing the meat.

Cook's Work Lightened. Washing greasy skillets is eliminated when these aluminum-foil liners are used. Made by the Panette Company, of Pittsburgh, in sizes to fit standard frying pans, the liners also may be used alone for baking. After use, they are discarded—along with all the grease and scraps that may cling to them.



Light Resembles Blind. A fluorescent lighting unit distributed by Thunder and Associates, of Chicago, is framed to simulate a window with Venetian blinds. Measuring 29″ by 41″, the unit includes two 50-watt cold-cathode tubes. The blinds may be adjusted so that the unit provides either direct or indirect illumination.

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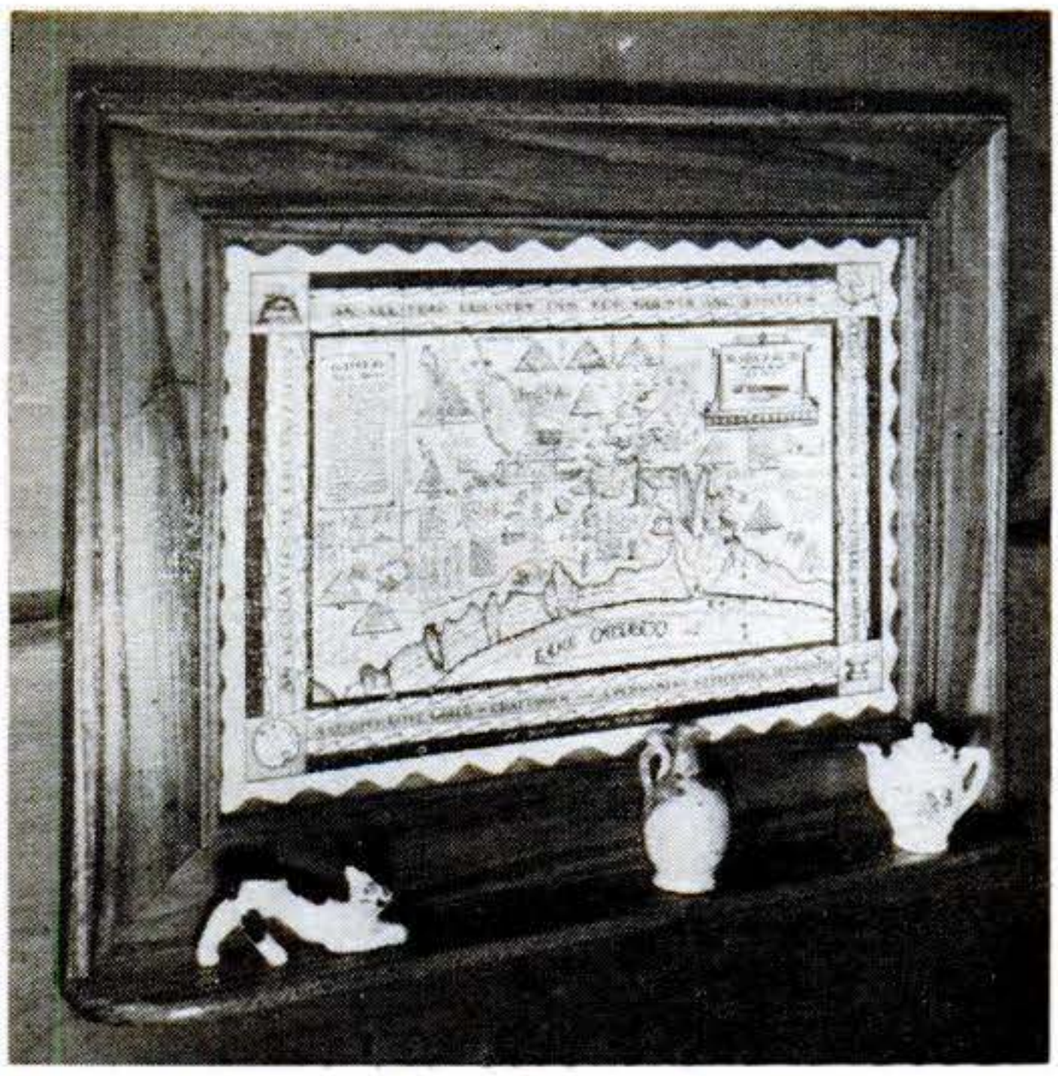
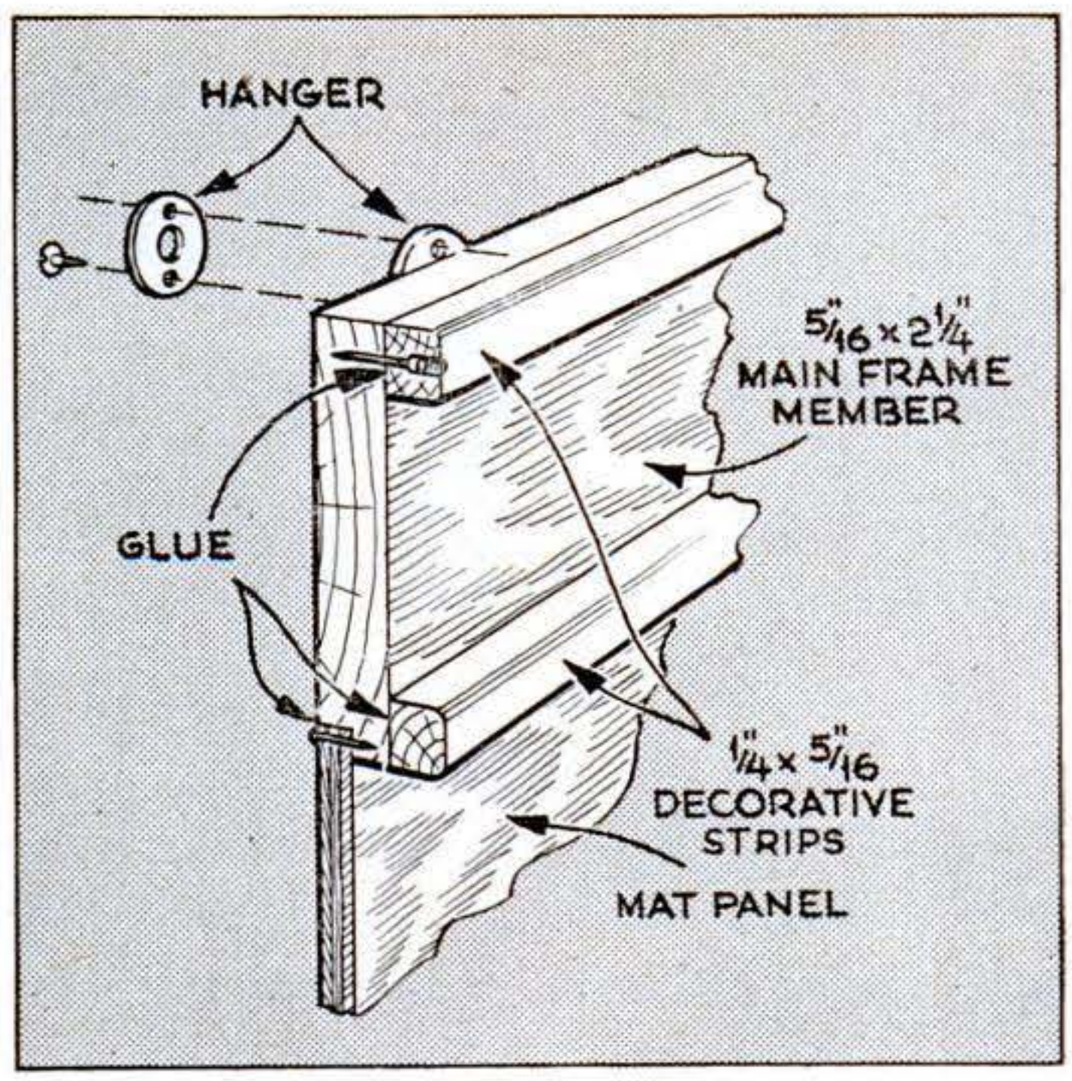


Souvenir items from the region illustrated by the map find an appropriate spot on the shelf.



Washers with two drilled holes may be used as hangers. Assemble the frame with miter joints.

Framed Map Displays Bric-a-Brac

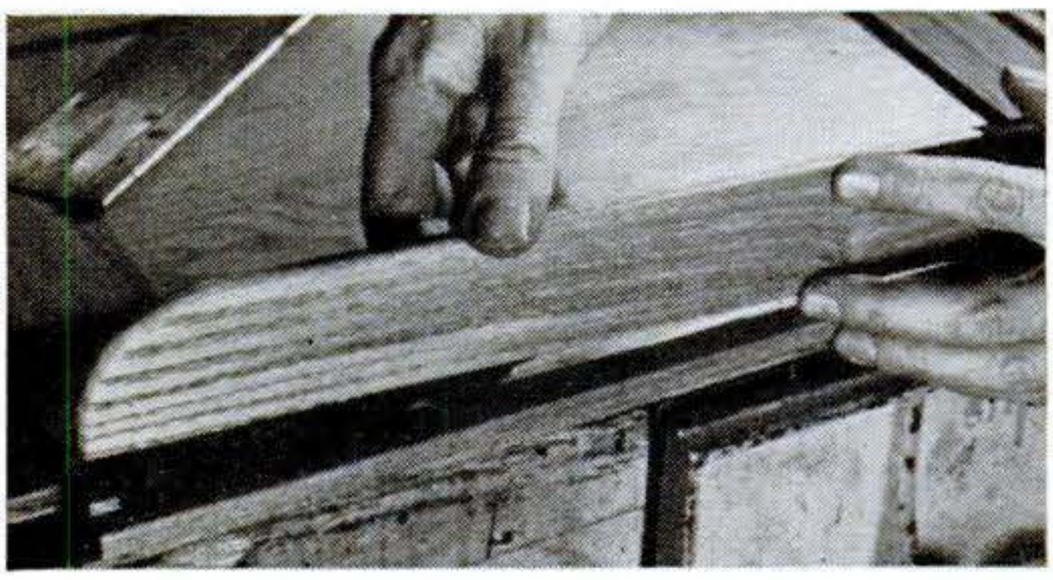
A PICTORIAL map and several small souvenirs from the area it represents are all effectively framed by this combination plaque and what-not shelf. Drawings, paintings, and photographs might be treated in the same way.

Dimensions will depend on the size of the map or other pictorial subject used. In this case, outside measurements of the frame are about 13″ by 17″. The map, actually a place mat, is glued to a central panel of ⅛″ plywood.

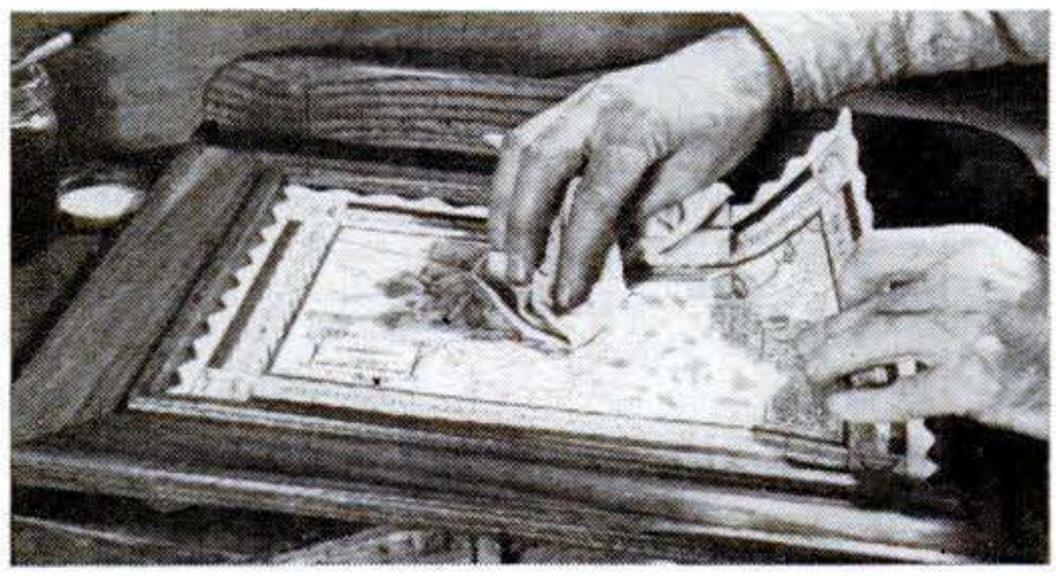
After cutting the main frame members from white pine, chestnut, or other wood, rabbet the inner edges ⅛″ by ⅛″ to receive the panel. Along each edge of the front, glue and brad strips ¼″ by 5/16″, ripped from the same stock as the wider pieces. Omit the strip from the outer edge of the lower piece, and in its place fasten a narrow shelf of 5/16″ or ⅜″ stock.

Colonial stain looks good on pine or chestnut. Follow this with a thin coat of shellac and two of wax. The central panel should also be stained, either a matching or contrasting color, if a border strip is left around the map or picture used.

After staining, apply a coat of shellac over the panel to prevent the stain from bleeding through the paper. The picture then should be attached with an adhesive that sticks to shellac, such as a quick-drying household cement. Next, size the paper by spreading water-soluble glue thinly over its surface with a putty knife. When this is dry, apply two coats of clear lacquer or varnish to the surface.—WALTER E. BURTON.



A shelf about 2″ wide is attached with glue and nails along the lower edge of the frame.



Glue the mat to the panel, size it, and then protect the surface with lacquer or varnish.

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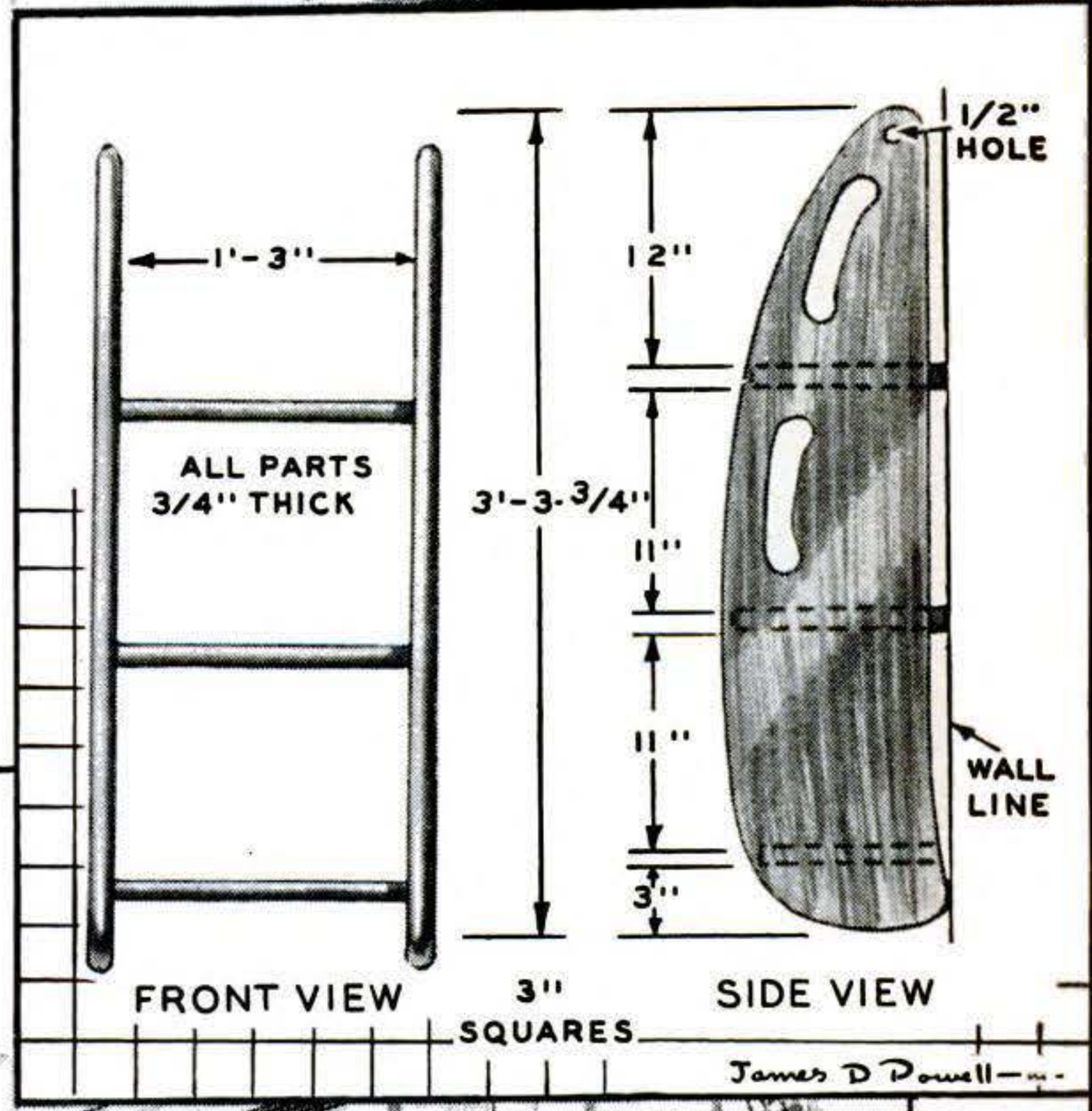
Boarding Ladder Bookshelf

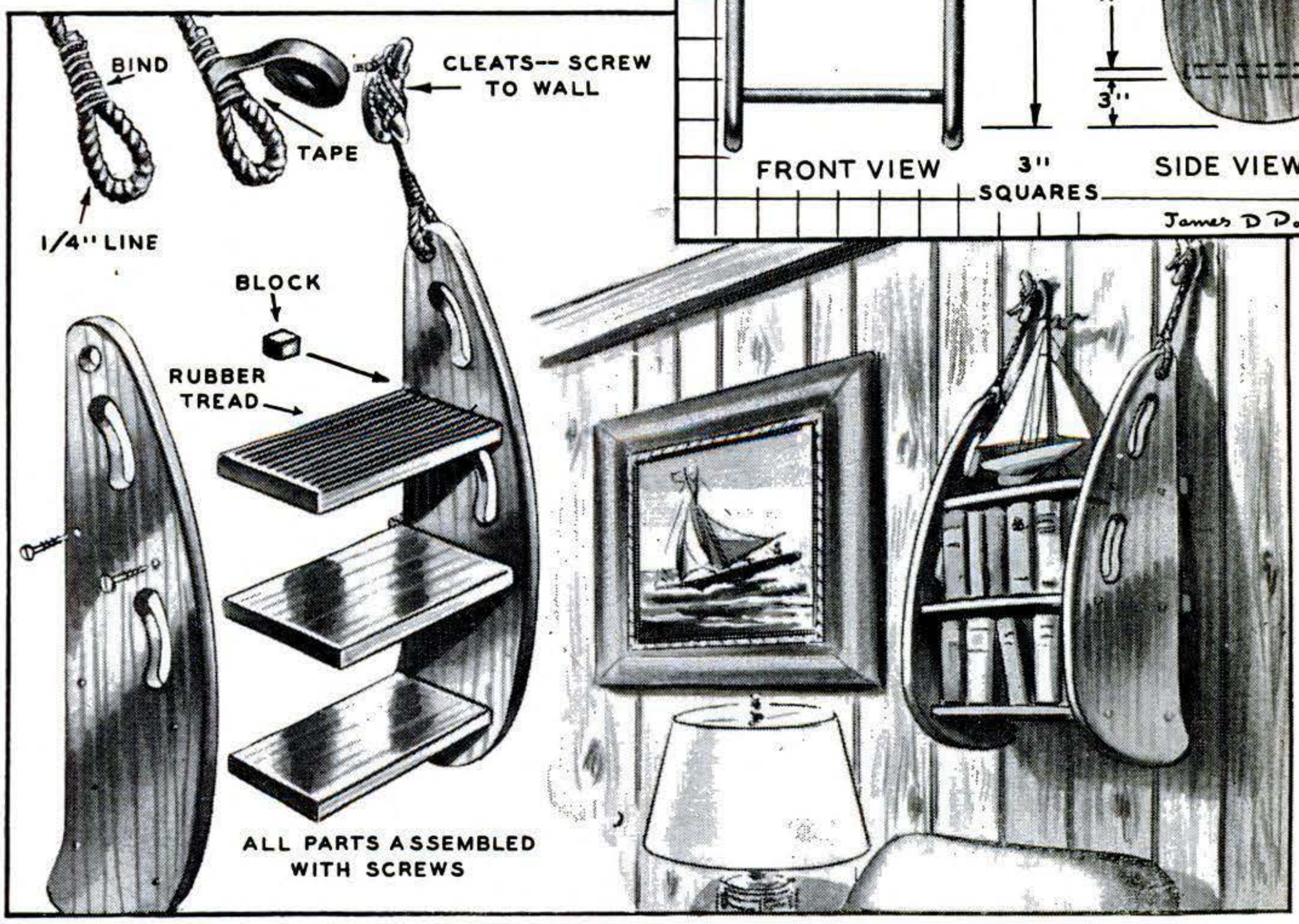
By James D. Powell

TAKEN straight from the side of a boat, this boarding-ladder bookshelf will bring the tang of the sea into your den. Nautical cleats and served-line fastenings contribute to the salty atmosphere.

Make all the parts of mahogany if it is obtainable. If not, use any other hardwood and apply a mahogany stain. After cutting, sand the sides and shelves to a smooth finish, rounding all edges of the sides and the front edges of the shelves. In assembling, countersink the screws and plug with dowels shaped from some of the scrap. Tack or cement rubber stair treads on the shelves. Place two blocks behind each side-piece to keep the shelves level.

Loop ¼" rope through each hole, binding it with twine and black tape. Wind the line around the cleats in a figure eight and take a couple of half hitches on the top arm.





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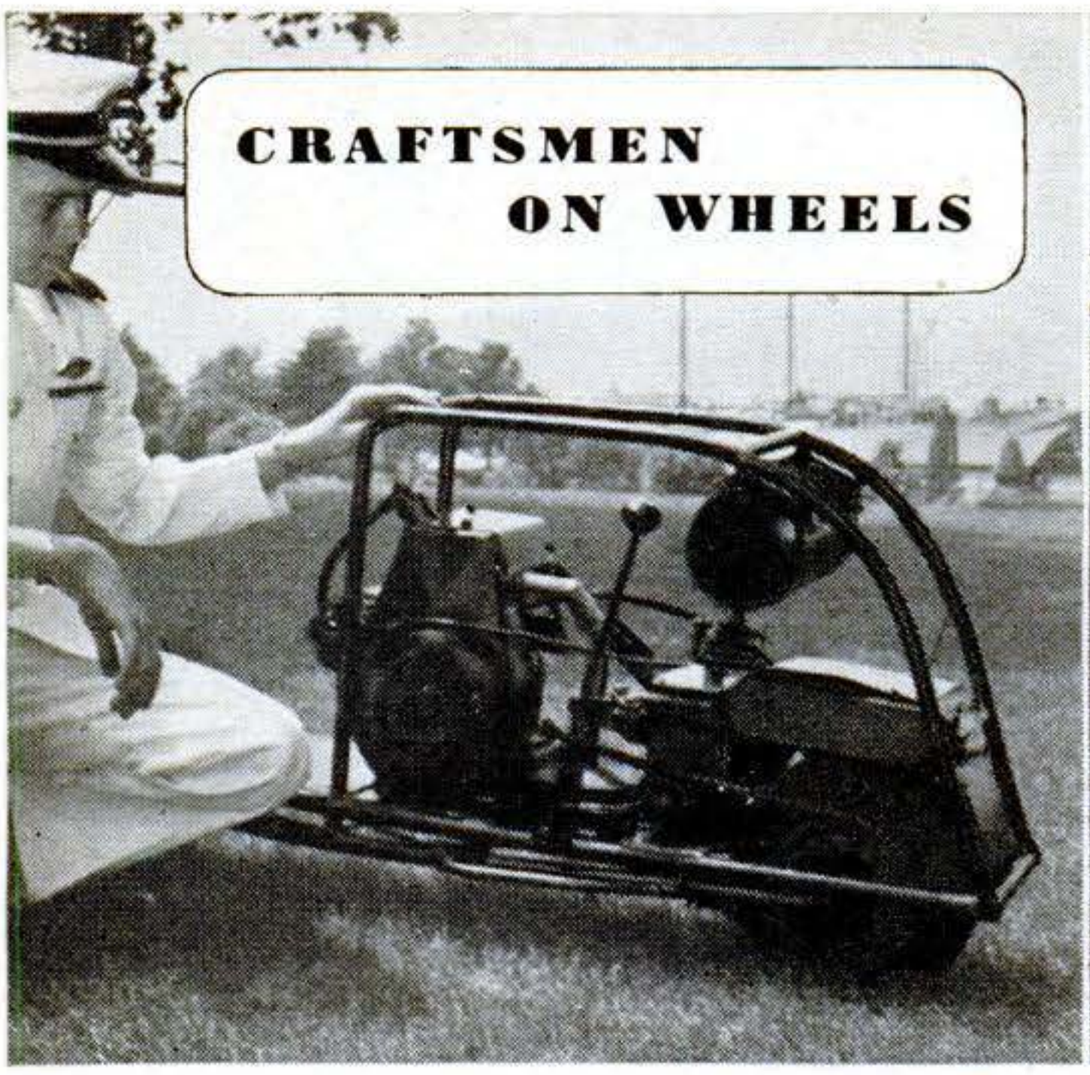
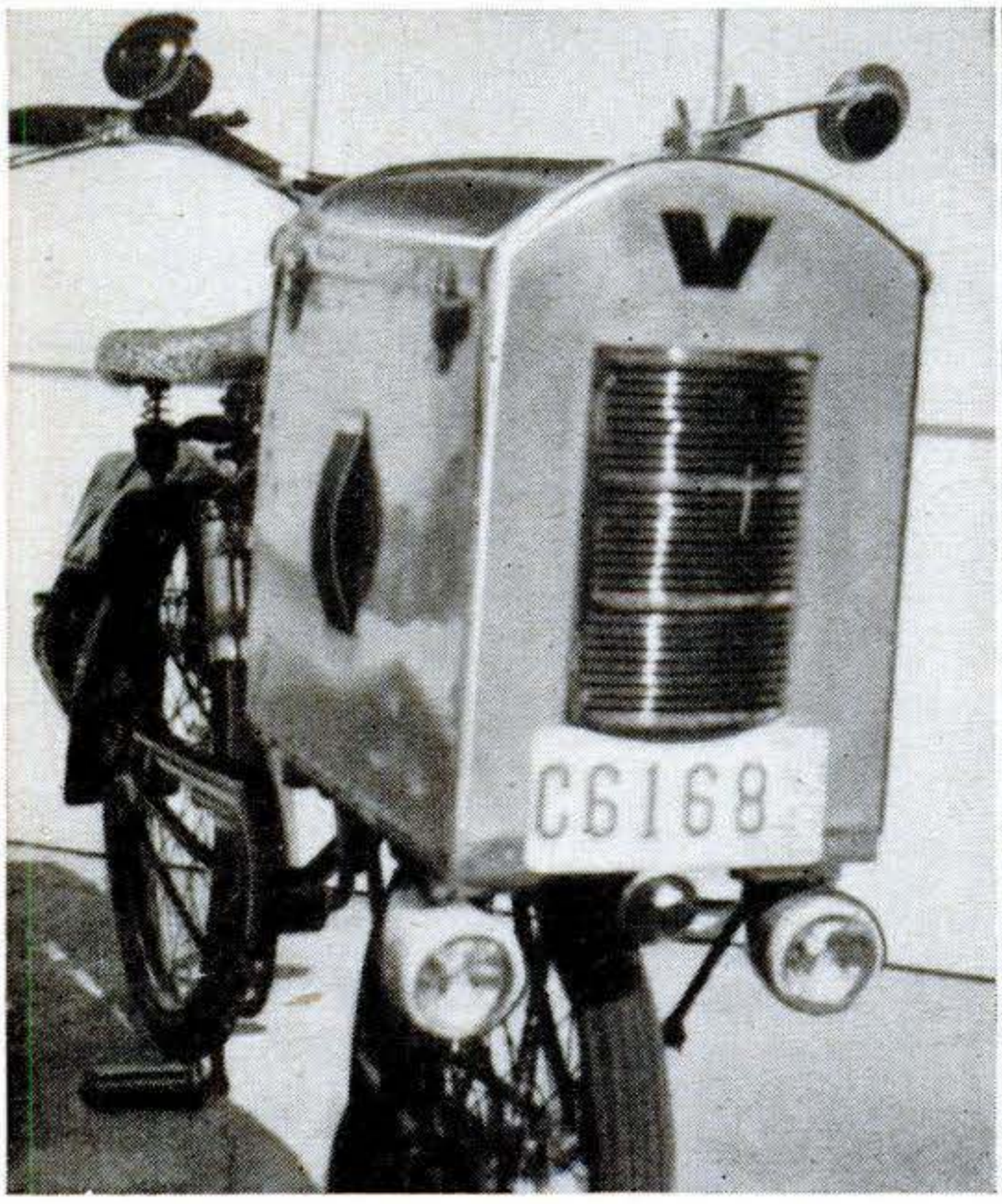
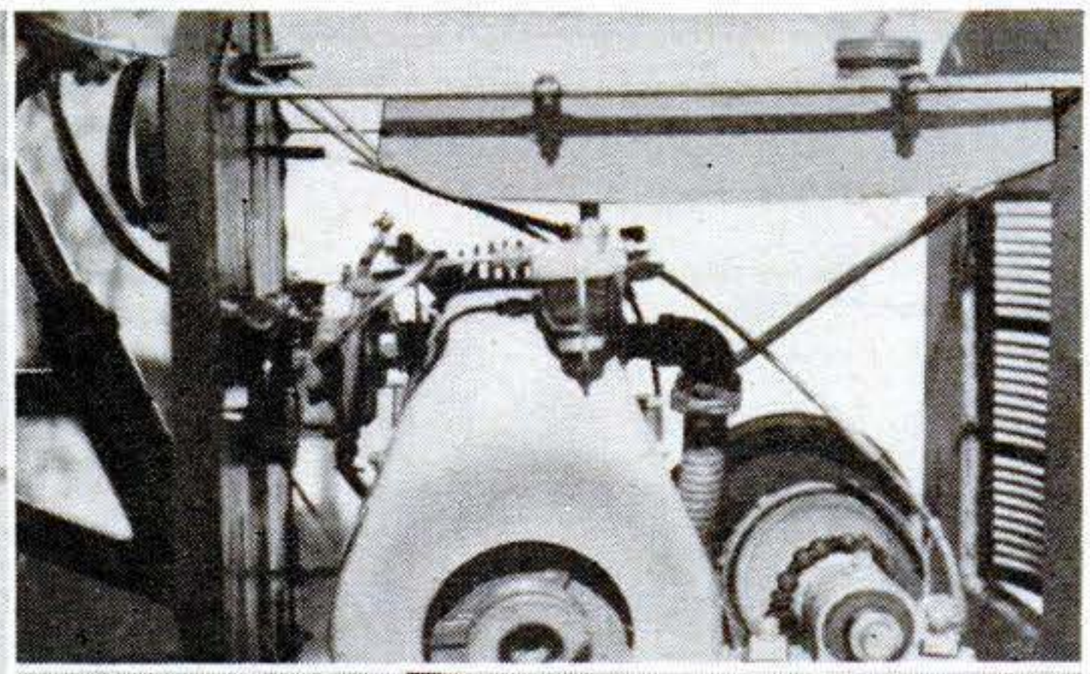
CRAFTSMEN ON WHEELS



Scooter Has Three Speeds. Before becoming a cadet-midshipman at the US Merchant Marine Academy, William R. Kern welded some ¾″ pipe, added a few gears, chains, and a 1½-hp. motor, and came up with the two wheeler shown above. It carries him 80 miles on a gallon of gas at an average speed of 30 m.p.h. A V-belt the tension of which may be varied by an idler pulley acts as a clutch to engage the three-speed transmission. The latter transmits power to the rear wheel through a chain. Gears were cut on a milling machine and hardened.





Front Wheel Is Motorized. Using a standard bicycle as a base, Dr. William S. Voorhees constructed this unique front-wheel driven motorbike. In addition to the 2-hp. engine, the front housing holds a 1-gal. gasoline tank—enough for 120 miles. The motor is connected through a belt and a ball-bearing idler pulley to a countershaft which is geared to a sprocket on the front wheel. A brake on the countershaft is actuated by a handlebar lever; with this and the coaster brake, both wheels have braking action. Speeds from 6 to 42 m.p.h. may be obtained, and the bike is said to be quite stable on turns as well as straight runs. The speedometer works off the rear wheel.

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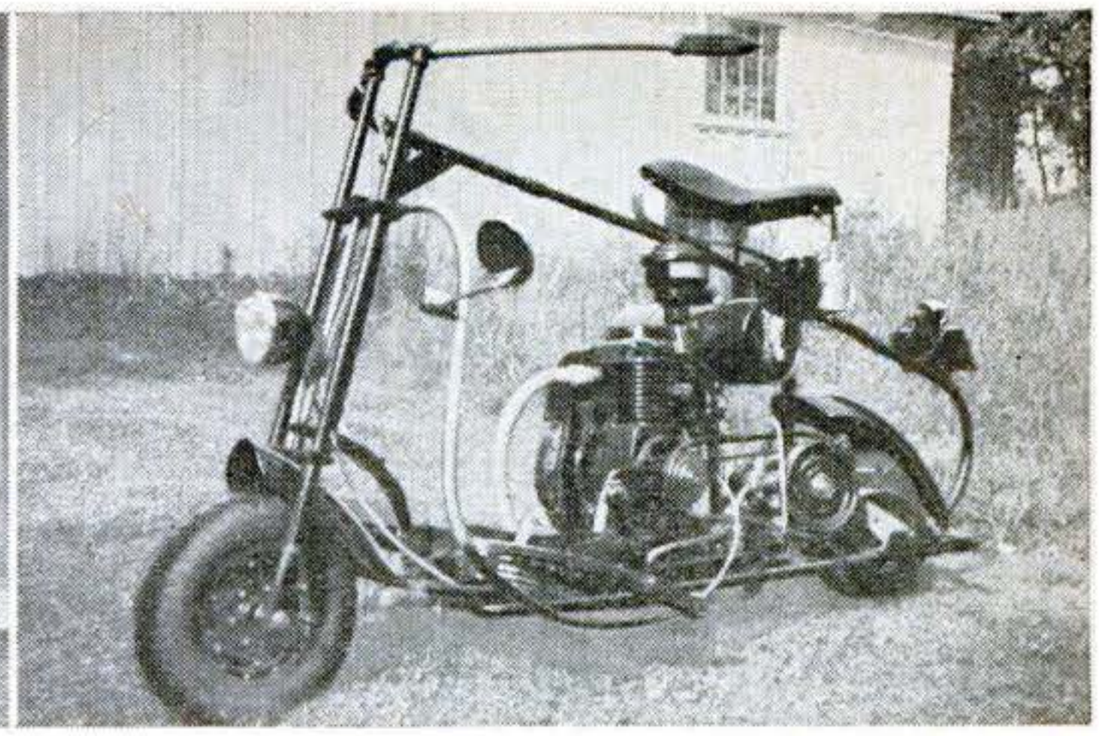
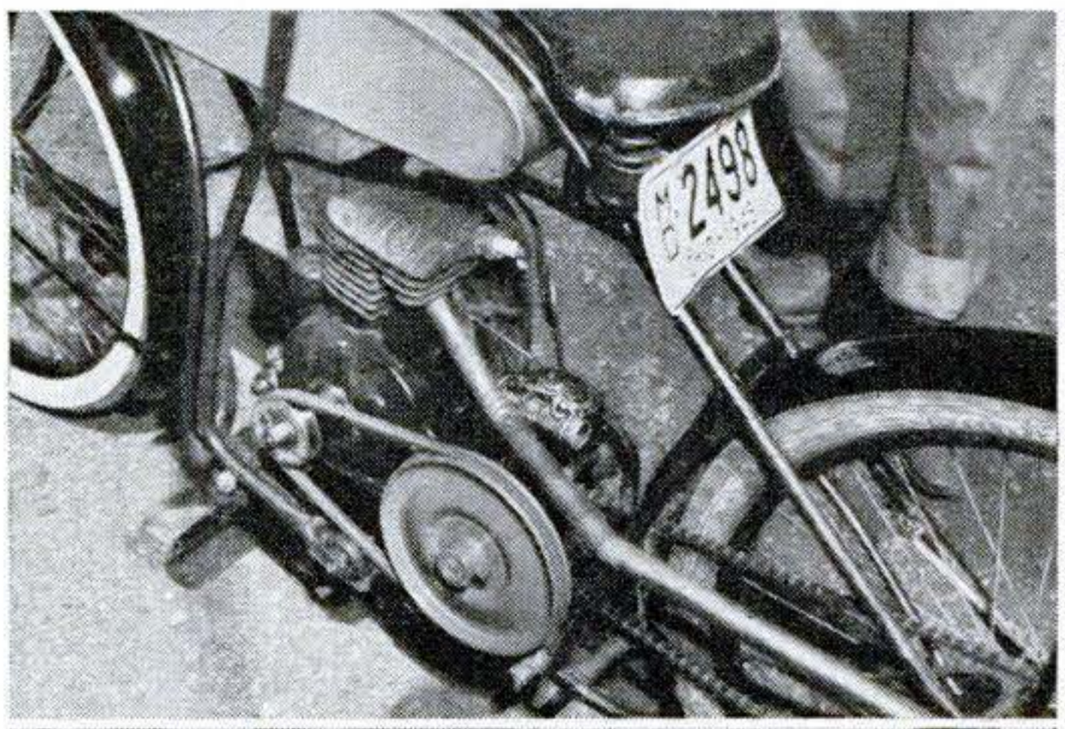
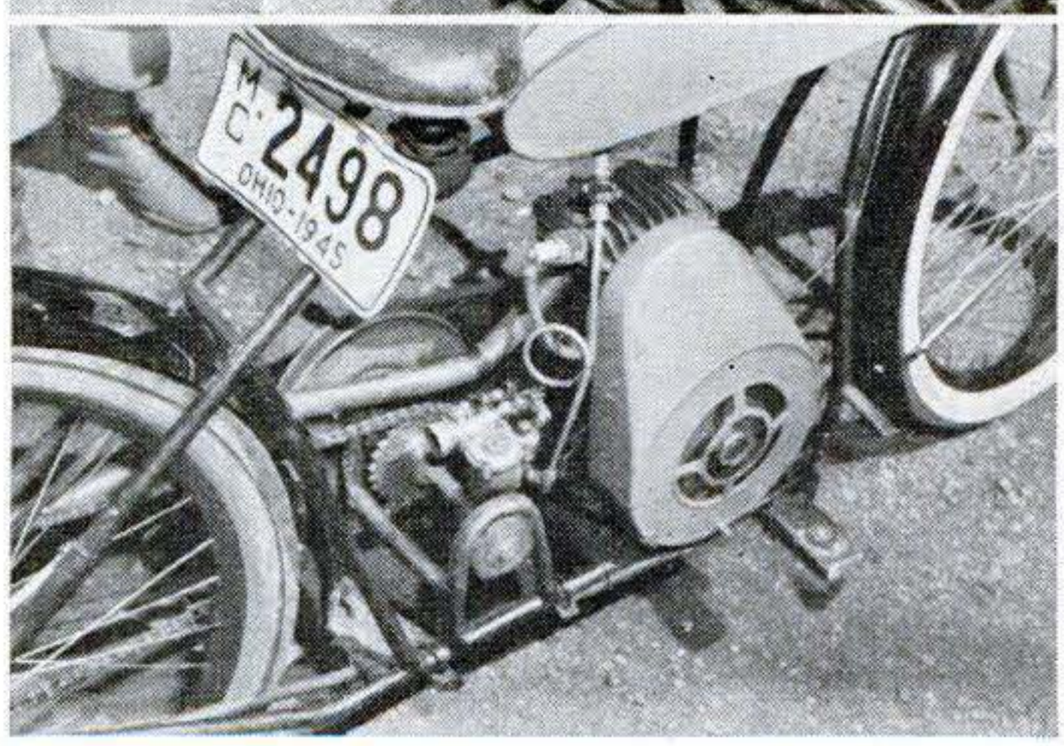


Scooter Takes Hills Easily. Employing a reduction of about four to one from motor to driven wheel makes this little scooter an excellent climber. Since it uses a 2.3-hp. engine, it still has enough power to cruise at 35 m.p.h. The Rev. J. Karlton Dewey, who built the machine, used ½" water pipe for the frame and welded all joints. Fittings are made from flat and angle iron. Clutch action is obtained through a jackshaft located just behind the motor. The shaft, which swivels in a horizontal plane, is moved by a pedal to slacken or tighten the drive belts in operation.





Motorbike Built from Scrap. Cast-off parts that he found lying around his father's machine shop became the raw materials for Robert Barr's lightweight motorcycle. A washing-machine motor, to which he added a carburetor for smoother performance, gives Barr a top speed of better than 40 m.p.h. Wheels, front assembly, and coaster brake were salvaged from old bicycles, and additions to the frame were made of ⅜" gas pipe. Drive pulleys and chain sprockets give a ratio of 6 to 1.

Aluminum Goes for a Ride. Bob Wurgaft gets a top speed of 25 m.p.h. from his aluminum-framed scooter. It uses a ¾-hp. washing-machine motor whose action simplifies the design. For one thing the machine needs no clutch because it starts readily with just a slight push; the brake was also omitted since it was found that motor compression stopped the wheels quickly after the motor was shut off. With two passengers a cruising speed of about 15 m.p.h. is obtained.

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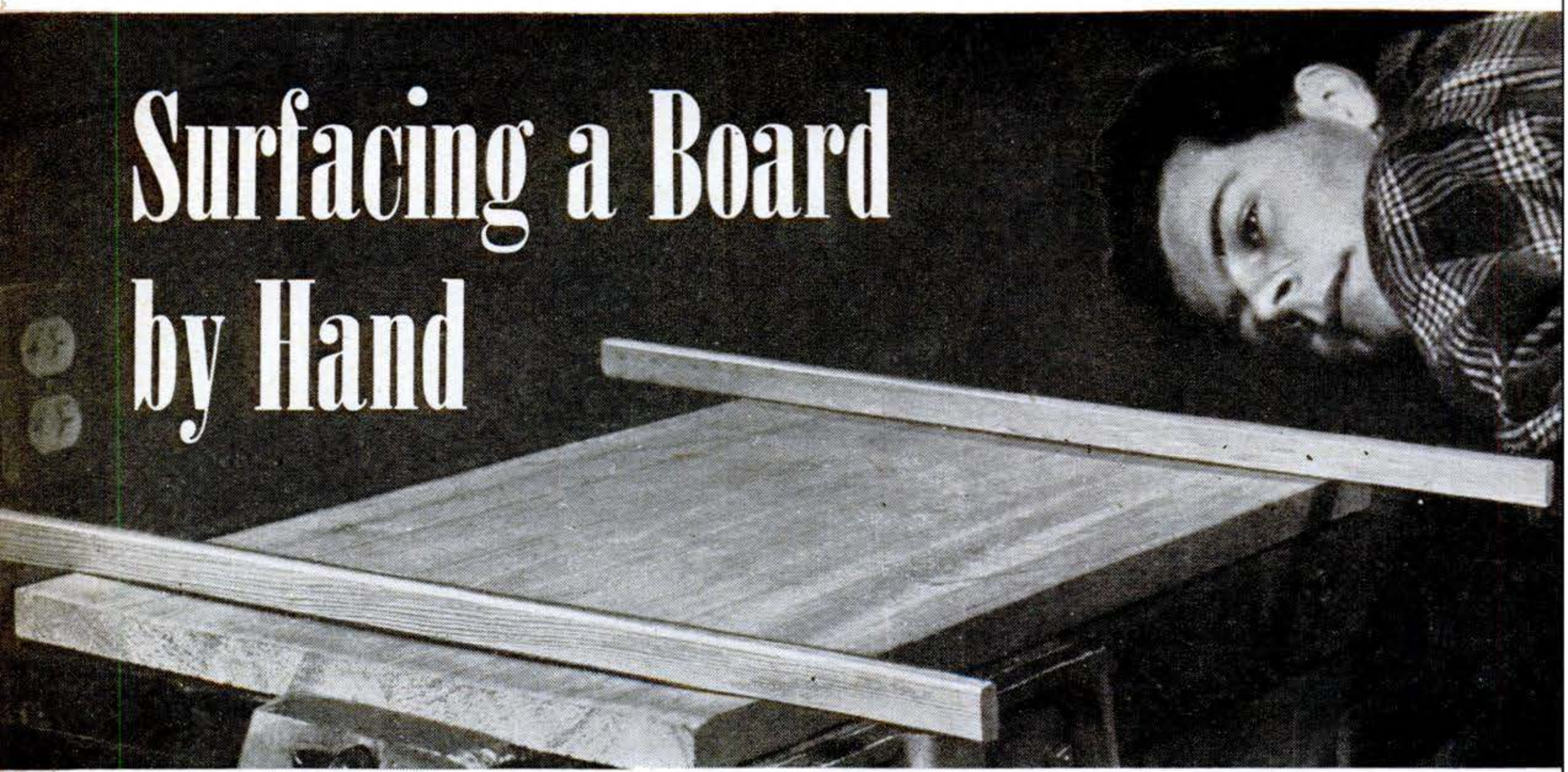
Surfacing a Board by Hand



Sighting over straight sticks laid across ends of a board reveals twist or, as here, cupping.

By Edwin M. Love

Woodworking is the favorite hobby both of the man who keeps handsaw and hammer in a drawer, and the one with a basement full of power tools. Whichever you are, here's a chance to check your methods against an expert's. This article begins a series by Edwin M. Love, noted woodworking authority, on how to do basic jobs with basic tools.

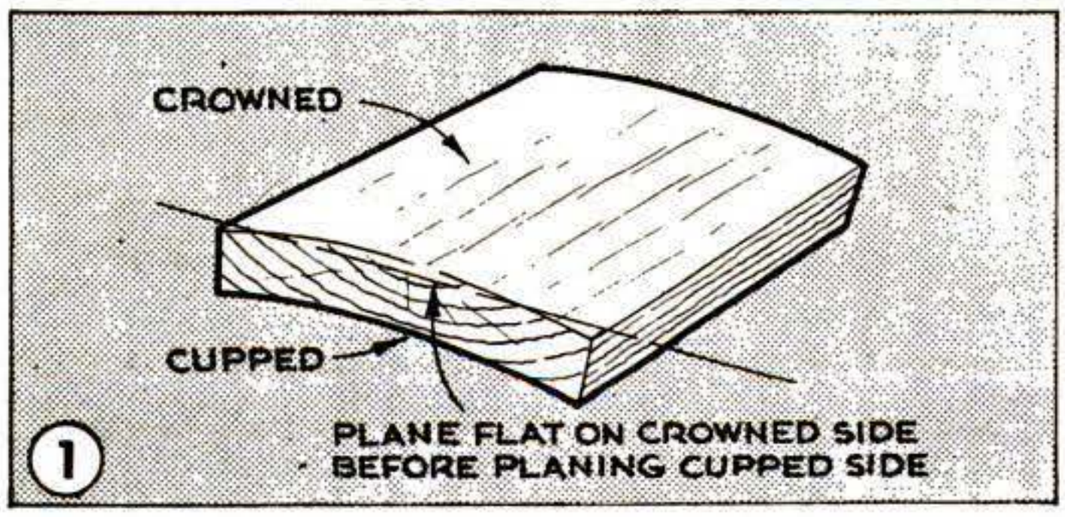
CABINET wood usually arrives in your shop machine planed and sanded. Is it perfectly flat? Very possibly, but don't bank on it. Your first step in any woodworking operation will be to test the face of a board and to true it up if it is crowned, cupped, rough, or otherwise deformed.

If you're working with hand tools, here's how to go about surfacing a board. Place the wood on a bench with the better side up, lay winding sticks across the ends as illustrated above, and sight across the sticks. If there is any twist, you can spot and mark the high corners.

Having discovered the high spots, you will want to level them off, but obviously this won't be easy unless the board rests securely on the bench. To plane a cupped board, lay it hollow side down; if only one side is to be finished and the cupped side is the better, plane a flat on the crowned side first (Fig. 1) so it will hold steady while the other surface is planed.

Most carpenters and many amateur woodworkers inspect wood for grain direction and lay the board on the bench with the grain inclining upward toward the stop. Where only a bench stop is used, the board must be shifted during planing so that the plane is directed toward the stop, or the board will swivel. If the bench is equipped with a tail vise, the work can be locked between pins (Fig. 2) with pressure applied lengthwise. But this clamping is useful only if the board is thick enough to resist buckling, for if the piece is planed while bowed up by edge pressure, as in Fig. 3, it will be hollow when taken from the vise.

Level the high corners of a board that has a twist by planing diagonally, and flatten



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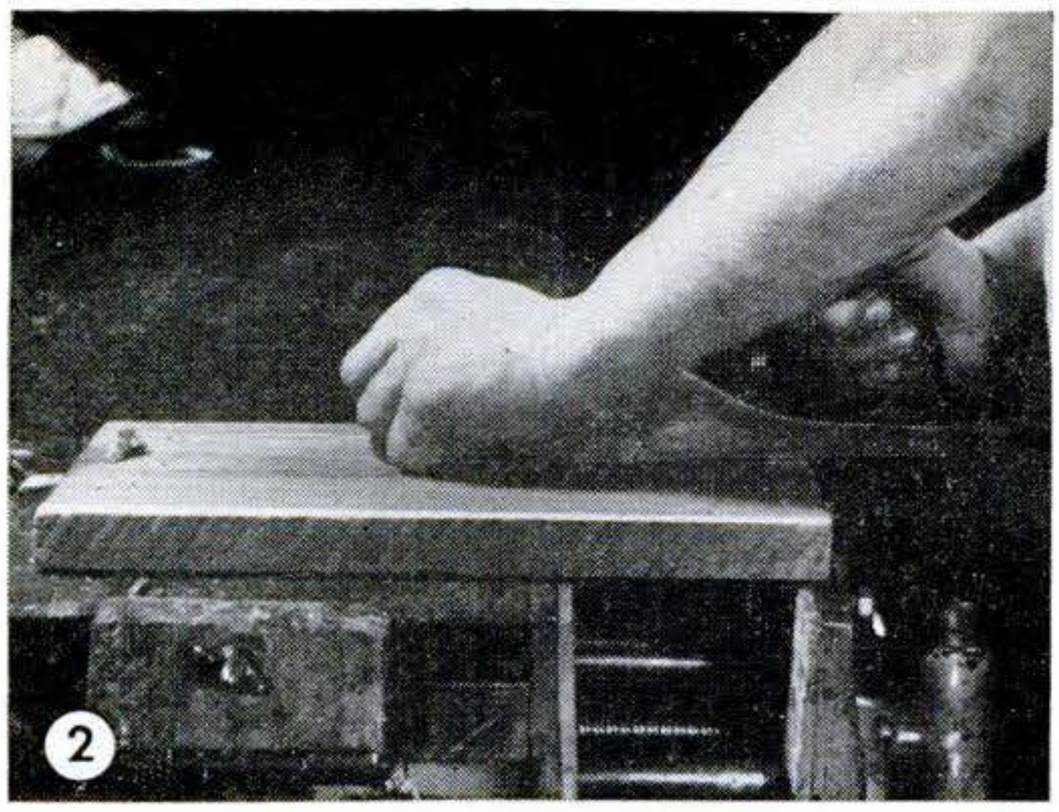

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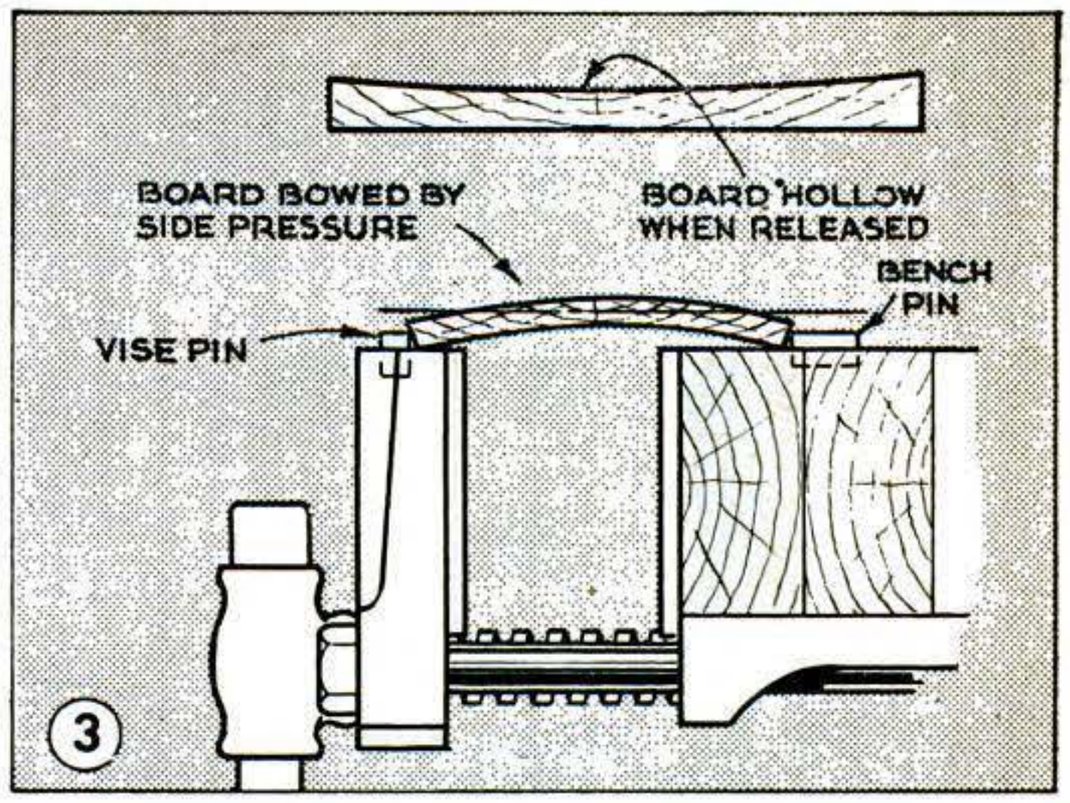

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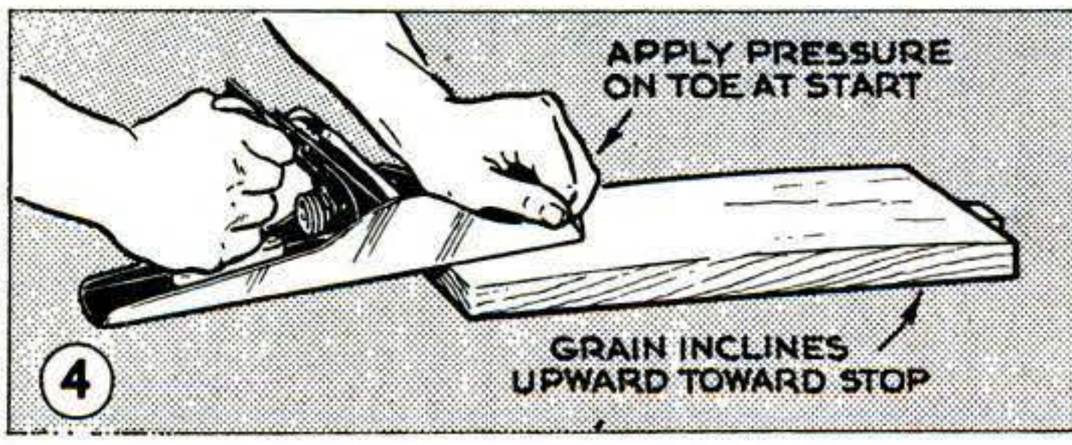

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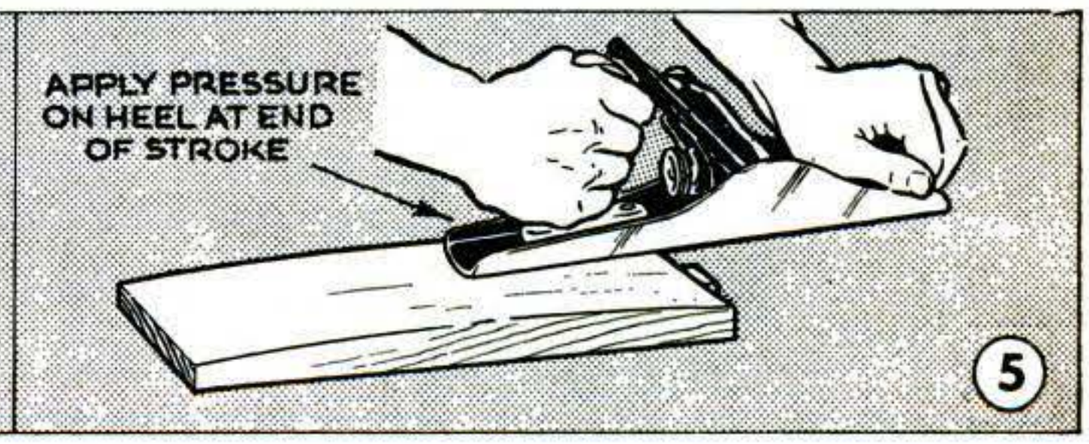

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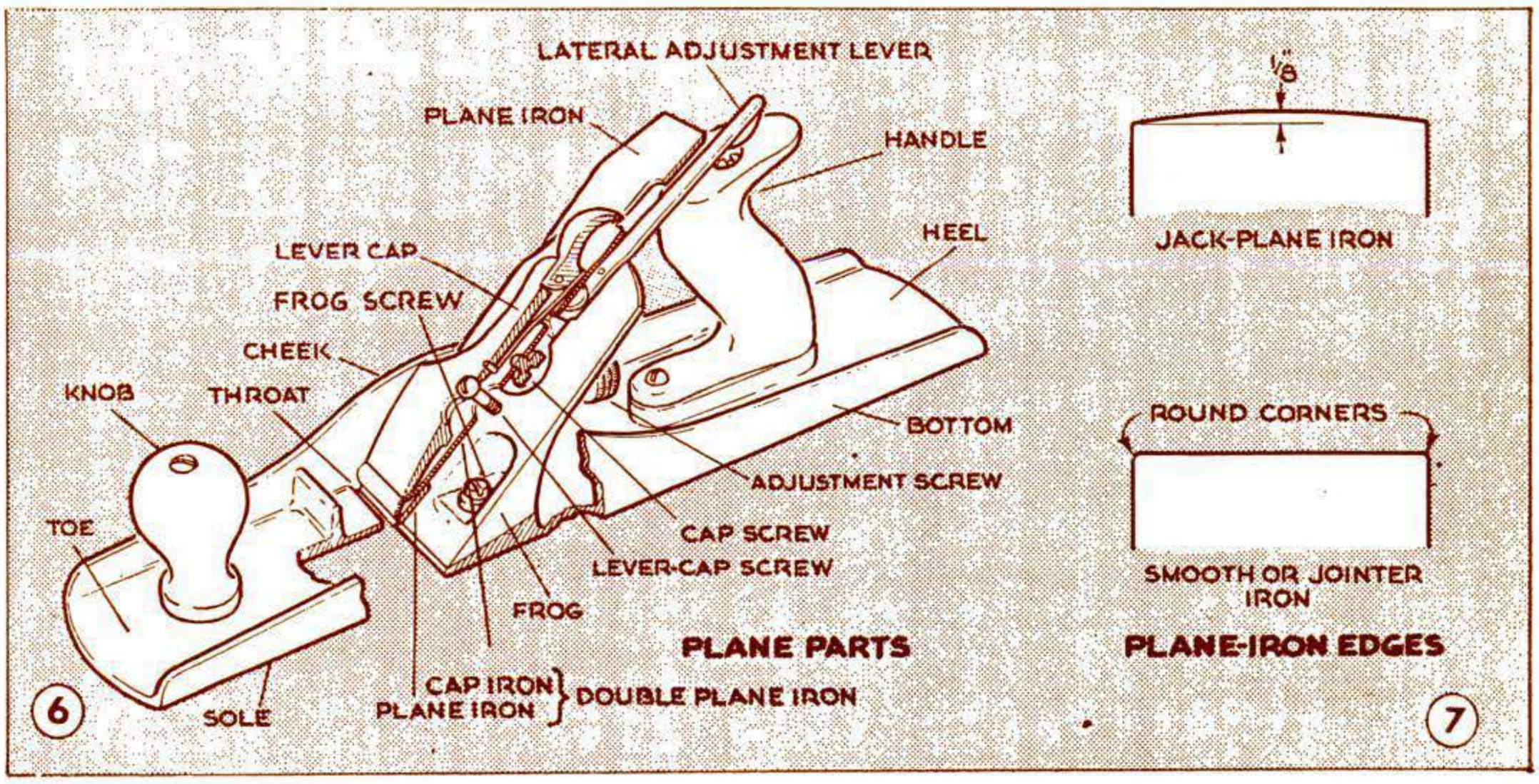
high edges or centers by planing parallel with the edges. Start a cut with firm pressure on the knob, and finish with pressure on the handle. Figures 4 and 5 show what you should do in this respect, and also how the wood becomes crowned lengthwise if the heel is allowed to drop at the start, or the toe at the end, of a stroke. Lift the plane and carry it backward for each new stroke; dragging the iron over wood helps wear the cutting edge.

Because the right plane is both a time and labor saver, carpenters and cabinetmakers use different planes for different purposes. Skilled amateurs, however, generally get along with only a smooth plane. If you have a selection, use a jack plane for the first cuts on a rough or twisted board. Its iron is sharpened with a crowned edge, causing it to cut a broad groove, and the cap is set back from the edge nearly ⅛″, allowing the shavings to pass freely through the throat on heavy cuts.

Like the smooth and jointer planes, the jack plane consists of a rigid body, a handle and a knob by which it is pushed, a frog with an adjustment device to carry the plane-iron assembly, a double plane iron, and a lever cap. The double plane iron is made up of the plane and cap irons, which



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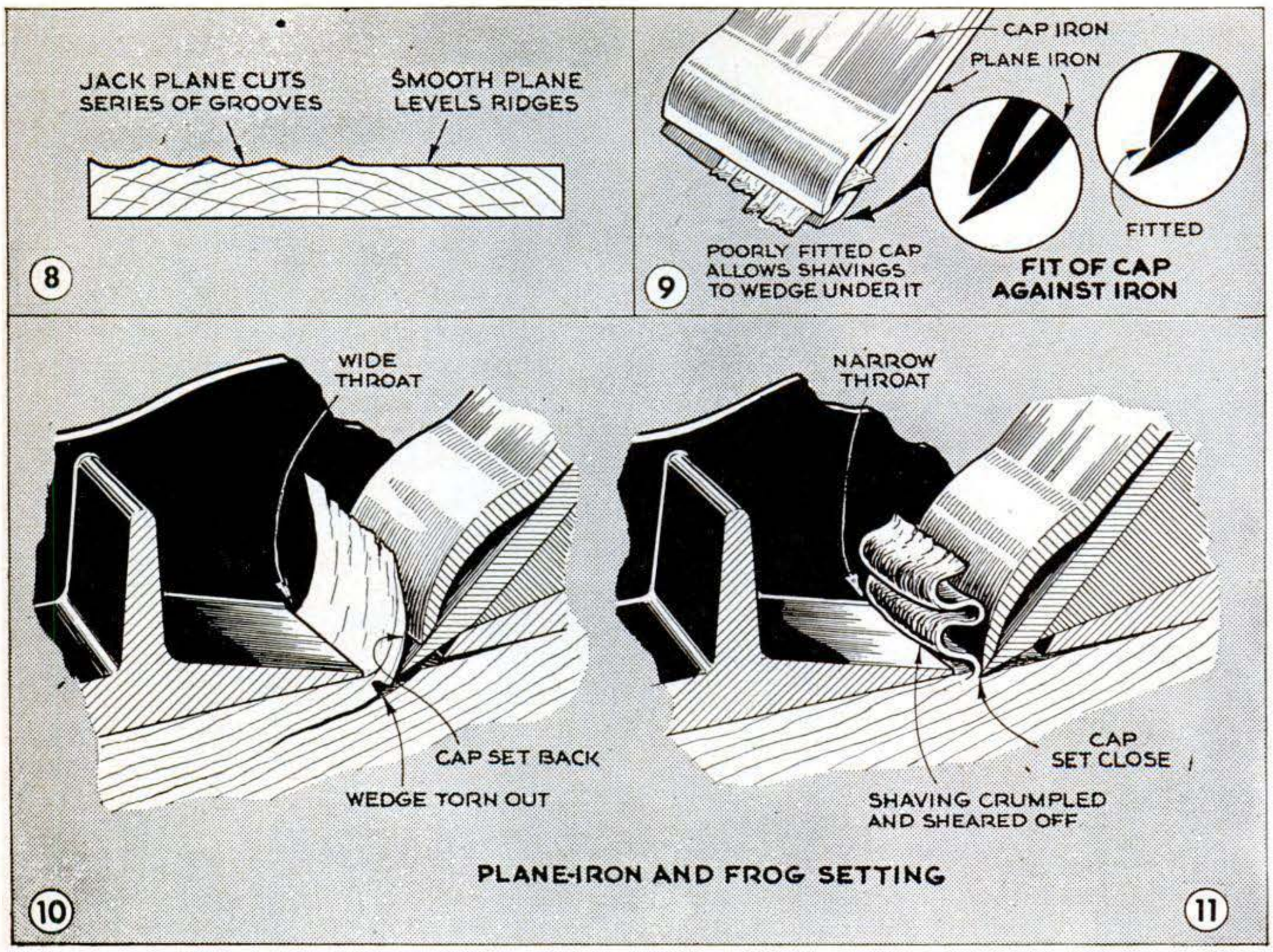
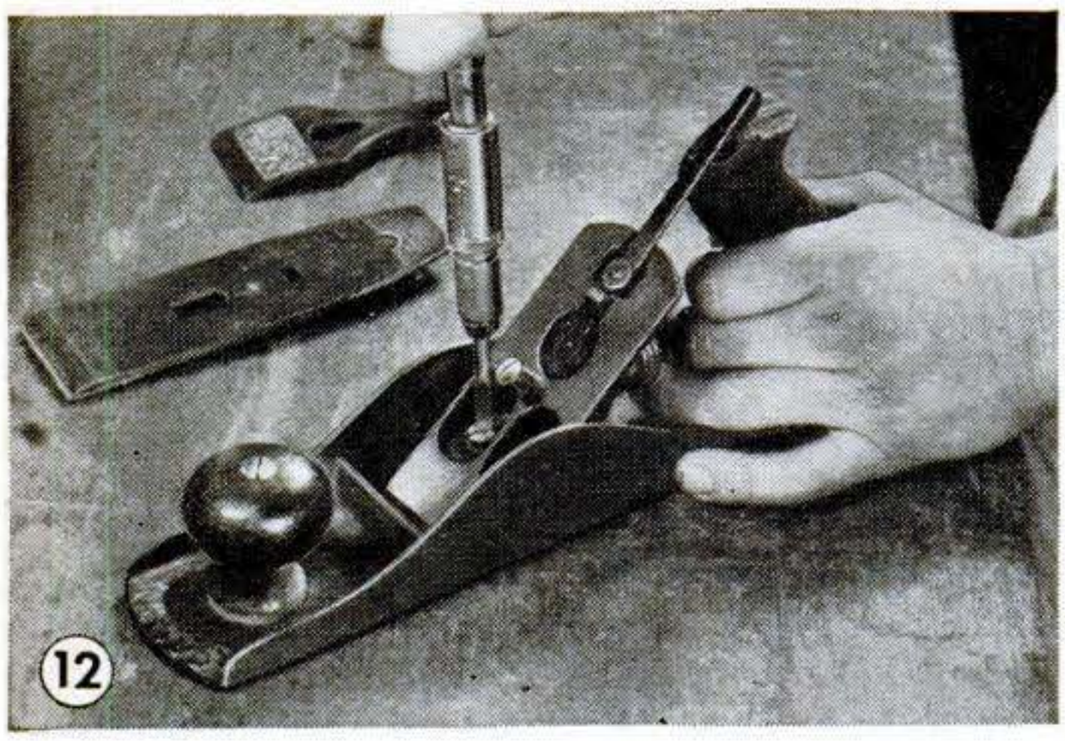


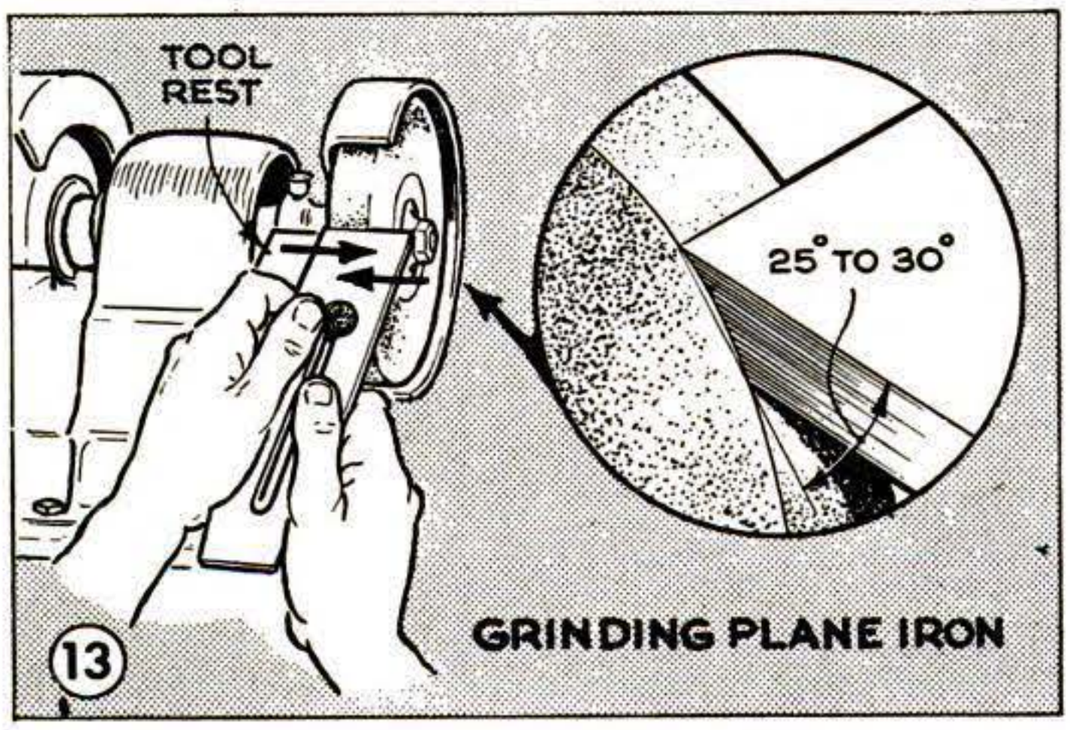
are held together by a cap screw. These and other plane parts are detailed in Fig. 6, cutting edges in Fig. 7.

Shaving thickness depends upon the amount of iron that projects beyond the sole of the plane. Check this projection by sighting along the sole from the toe, or, as many prefer, by passing your forefinger lightly over the throat. Turn the adjustment screw to regulate the depth of cut, and if one corner digs in, move the lateral adjustment lever toward that side.

Once the high spots are leveled, work progressively from left to right, "chasing the shavings" by overlapping the strokes. Take a deep enough cut to expose fresh wood over the entire surface; there is no point in wasting time with extra cuts. The jack plane finishes the board in a series of grooves (Fig. 8), but leaves it straight lengthwise. A smooth or jointer plane removes the ridges and leaves the work flat.

Straight-grained wood planes easily, but on cross-grained stock the iron tries to follow contrary grain into the board (Fig. 10). When it succeeds, it pries up a wedge and tears it out. Taking a thinner shaving helps, but does not entirely eliminate this ragged pitting of the wood. The remedy is to remove the double iron, loosen the screw, and





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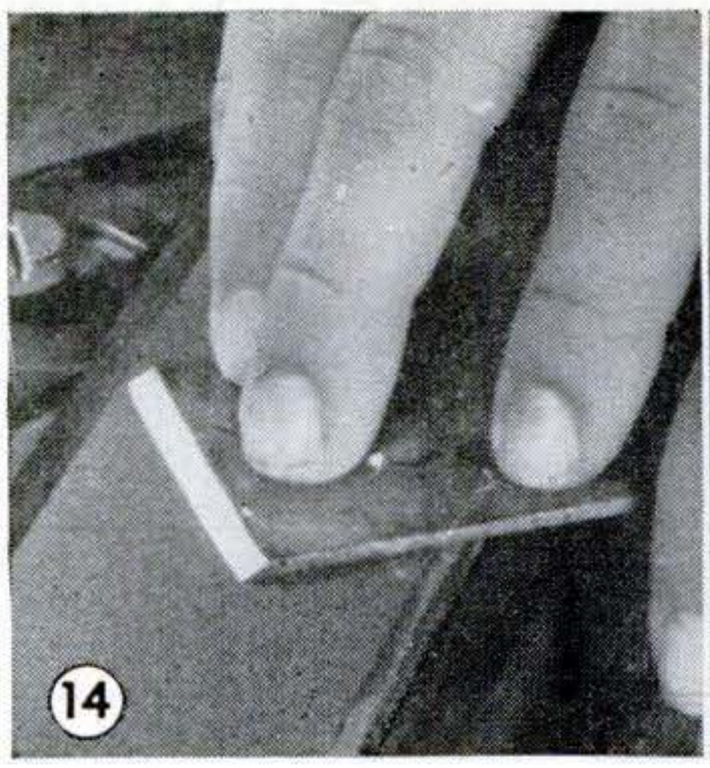
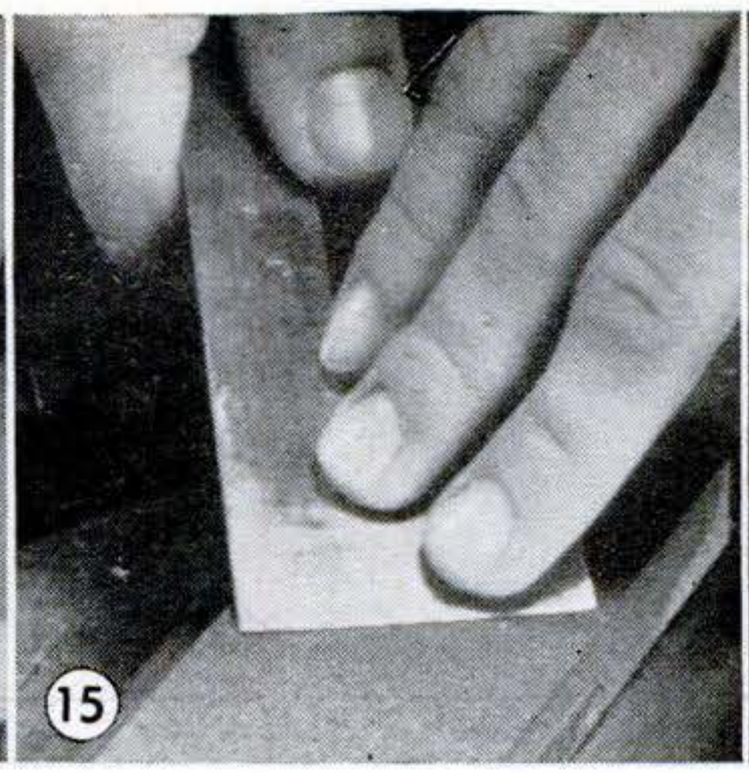




slide the cap down to 1/64″ from the edge of a smooth iron (or as close as possible on a jack-plane iron). When you take a thin cut with this setup, the weak shaving or wedge tip will break against the cap at the time it is parted from the wood (Fig. 11). Smooth cutting of very contrary grain is further improved by setting the frog forward to narrow the throat.

With the cap set close, the plane becomes a little harder to push and it may therefore be necessary to tighten the lever-cap screw (Fig. 6)—but not so tight that the projection of the edge cannot be adjusted.

A plane will choke—especially on poorly seasoned wood—if too heavy cuts are attempted, or if the throat is too narrow. Shavings wedge between the cap and iron and scoring results if the fit is poor (Fig. 9) or if the lever cap is not tight enough. Chattering is caused by a dull plane, a loose frog, or a cut that is too heavy for the setting of the cap. Be sure that the frog screws are tight (Fig. 12).

Neither speed nor accuracy is possible with a dull plane. The iron requires grinding if the edge is nicked, out of square with the sides, or dubbed off to roundness by too much whetting. While grinding, dip the iron into water frequently to keep from burning and softening the blade.

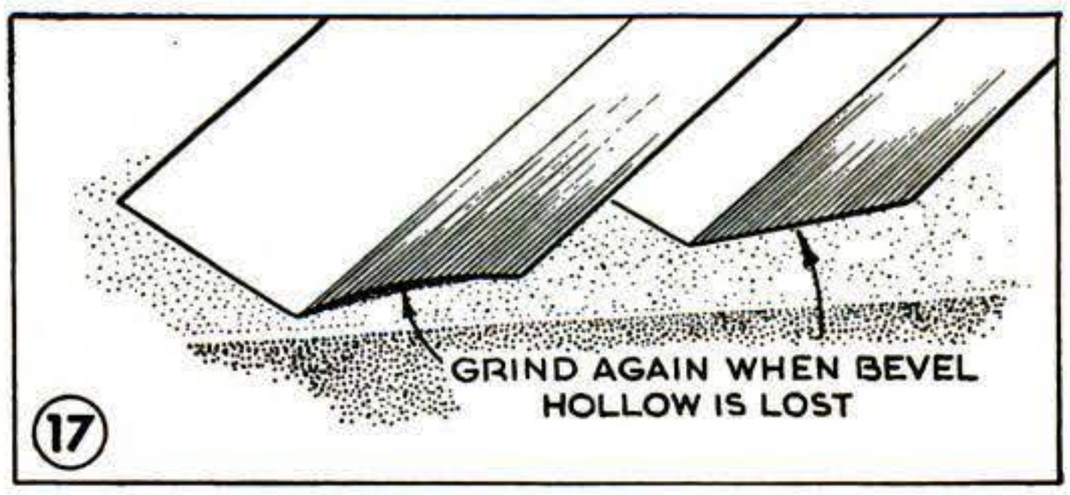
Adjust the tool rest on a grinder so that the blade is at an angle of 25 to 30 deg. and pass the iron evenly from side to side—as shown in Fig. 13—until a fine wire edge turns up. If the cutting edge is badly nicked, hold it perpendicular to the rim of the wheel and square it off before forming the bevel. Bevel width should be about twice the thickness of the plane iron. If a sharper angle is made, the blade will dull and nick easily; if blunter it will cut less efficiently.

To obtain the crowned cutting edge that is needed on a jack-plane iron, move the blade in a broad arc across the grinding wheel, rather than straight across as indicated by the arrows in Fig. 13.

A well-ground bevel is hollow and matches the curvature of the wheel. It is a pretty good rule to regrind the iron when the hollow has been whetted flat (Fig. 17). Fit a combination stone—coarse on one side and fine on the other—into a block and put a few drops of light oil or kerosene on the coarse side. Rub off the wire edge raised in grinding, laying the iron flat on the stone as in Fig. 14. The oil floats away the particles of metal, keeping them from clogging the stone. Wipe the stone clean and oil it again. Whet the bevel, holding it without rocking at the angle of grinding (Fig. 15). It is best to use long, straight strokes with medium pressure to wear the stone evenly. When a fine wire edge forms (felt by sliding the finger off the flat side of the iron) wipe both stone and iron and repeat the same operations on the fine stone. Whet off the corners of a smooth plane iron to keep them from scoring.

One method of assembling the cap and plane iron without striking the freshly whetted edge is illustrated in Fig. 16. Slip the cap screw through the plane iron while the edges are held apart as shown, then swing the two irons together. Slide the cap down toward the cutting edge and adjust the clearance before you tighten the screw.

TO BE CONTINUED



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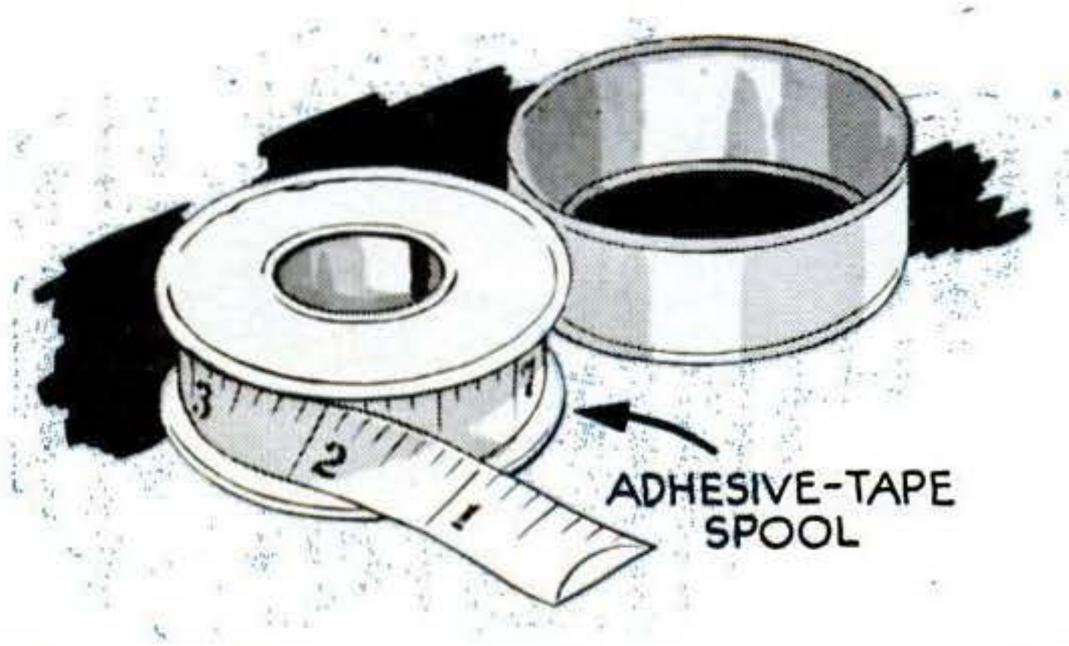
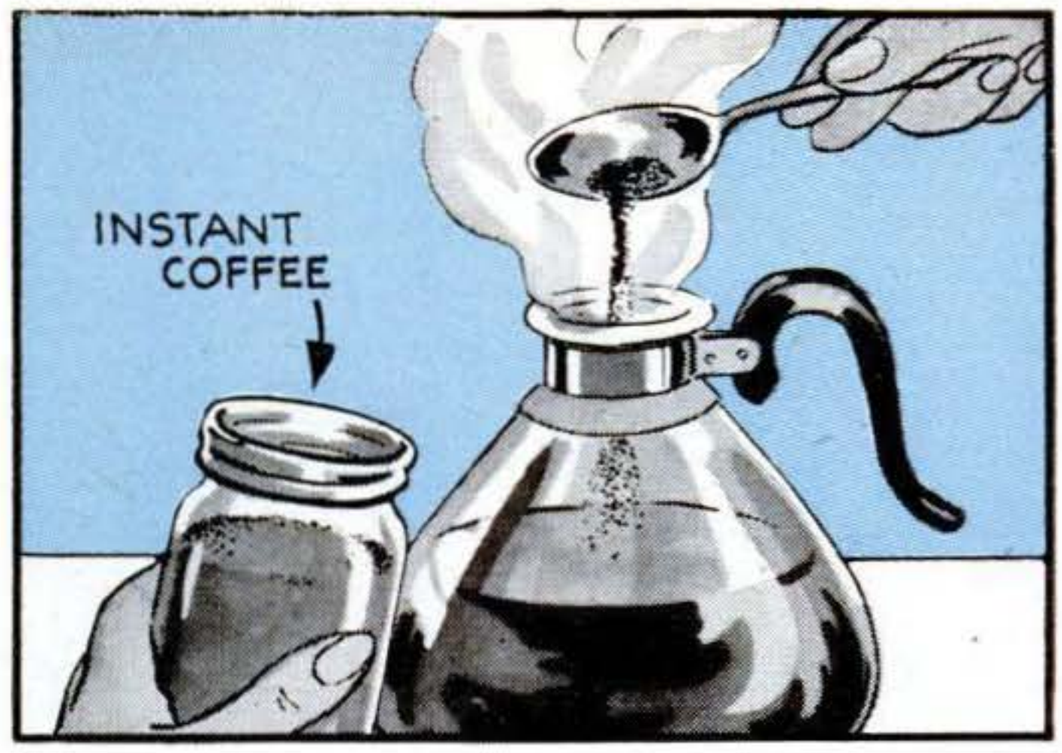
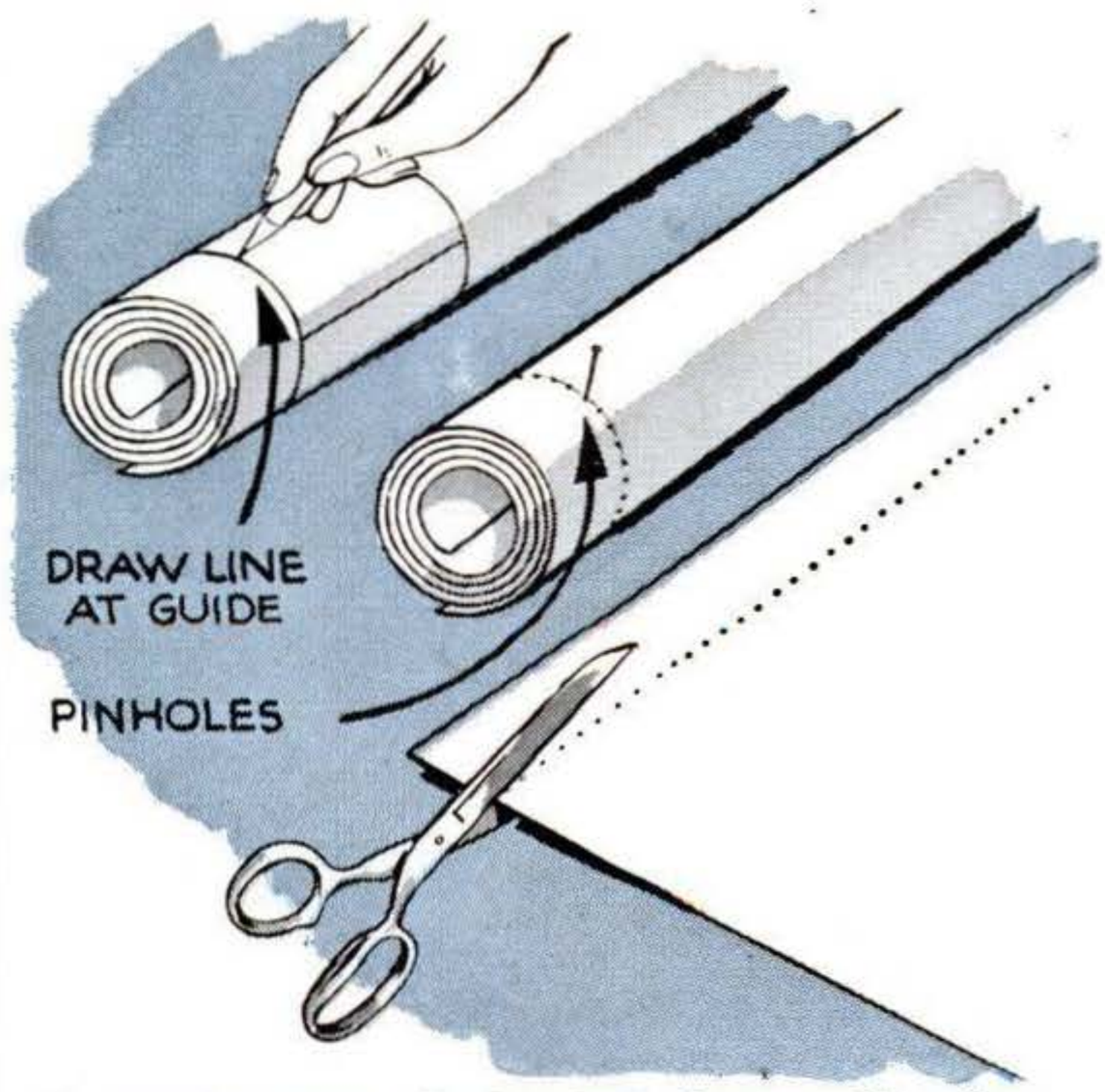
KEEPING THE HOME SHIPSHAPE



Empty adhesive-tape containers make excellent holders for tape measures. The tape should be wound up on the spool and the cover snapped on to protect against dirt and wear.



When you make a mistake in your measurements and brew weak coffee, add just a little instant coffee to the pot. It will bring the brew up to strength without spoiling its fresh flavor.



In cutting new shade cloth for an old roller, measure and draw a guide line around the roll. Make a pinhole every ¼" along this line, unroll the shade, and cut on the dotted line.

An old mirror kept in the kitchen will serve as a bulletin board for writing notes to the family. Hang a china-marking pencil nearby; it writes distinctly and washes off easily.

Small pieces of bric-a-brac that topple over every time a breeze stirs or a truck rumbles by can be anchored with tiny dabs of plastic weatherstripping or pieces of cellulose tape.

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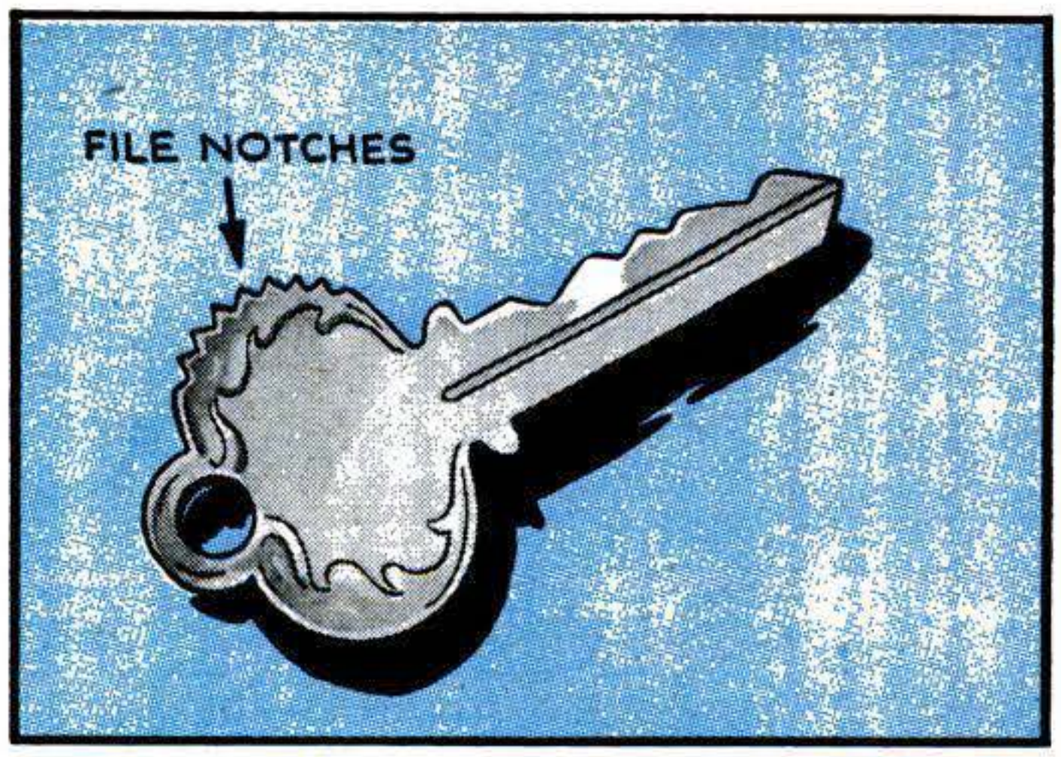
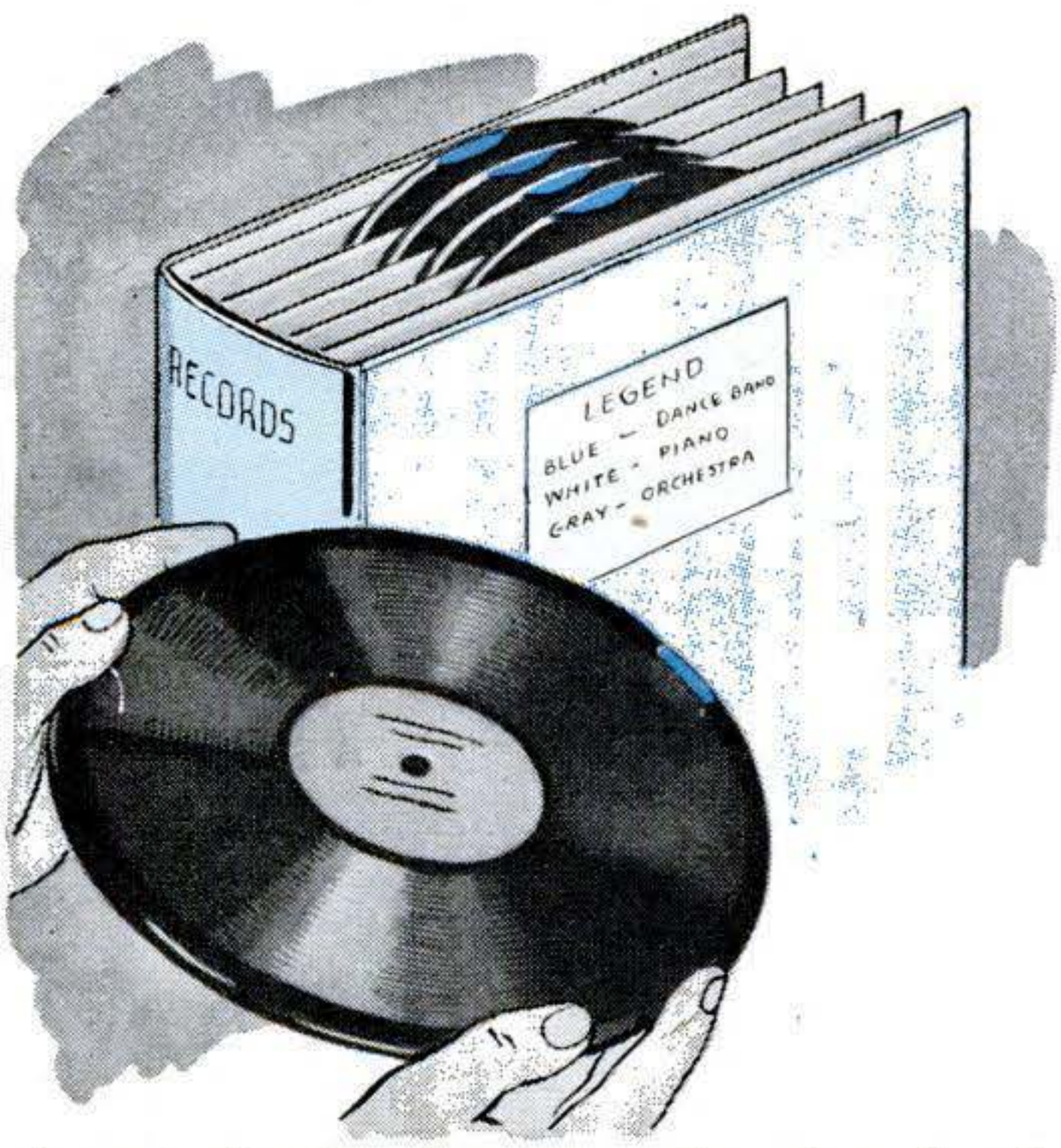
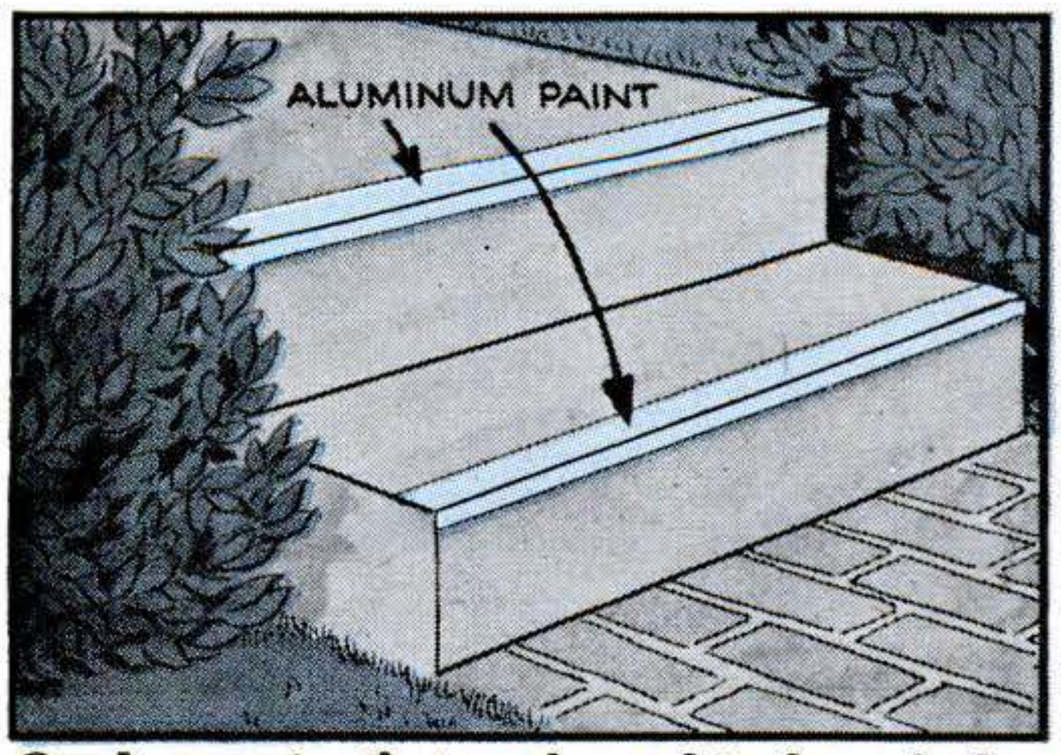


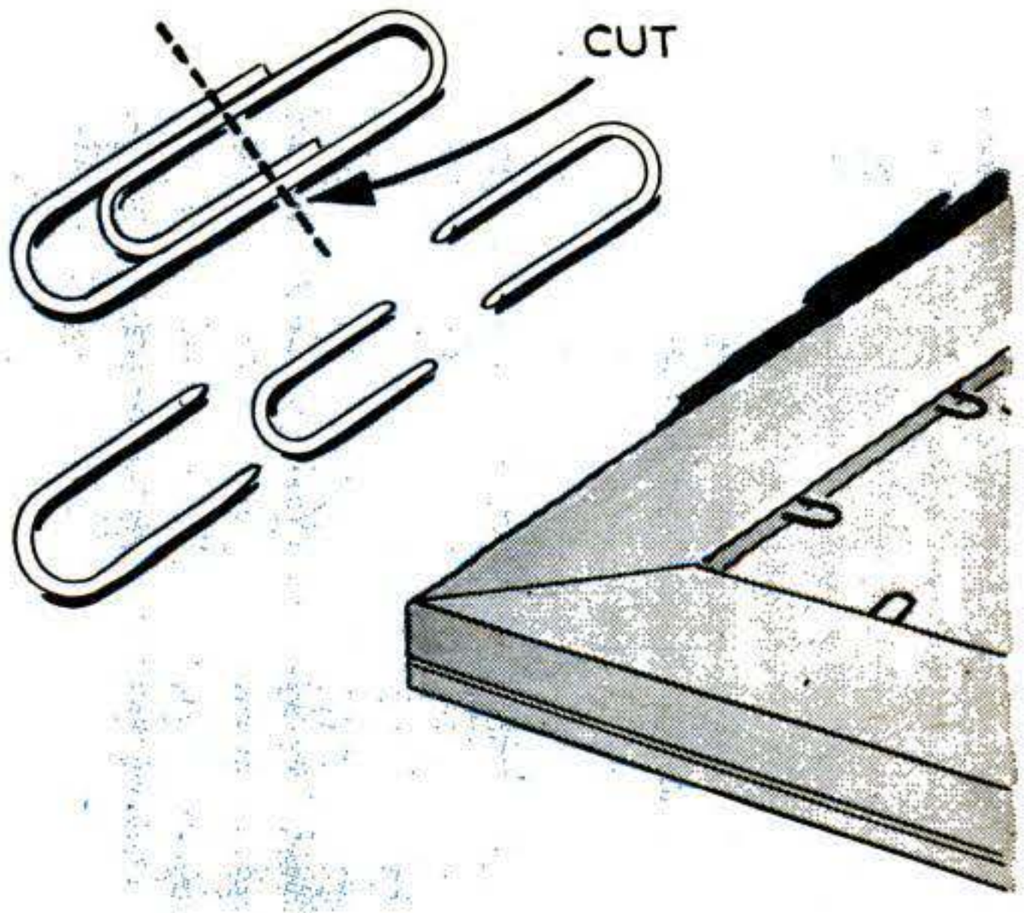
There's no need to fumble with your keys to select the right one for any particular lock and get it right side up. Filing identifying notches in the top will do both jobs at once.



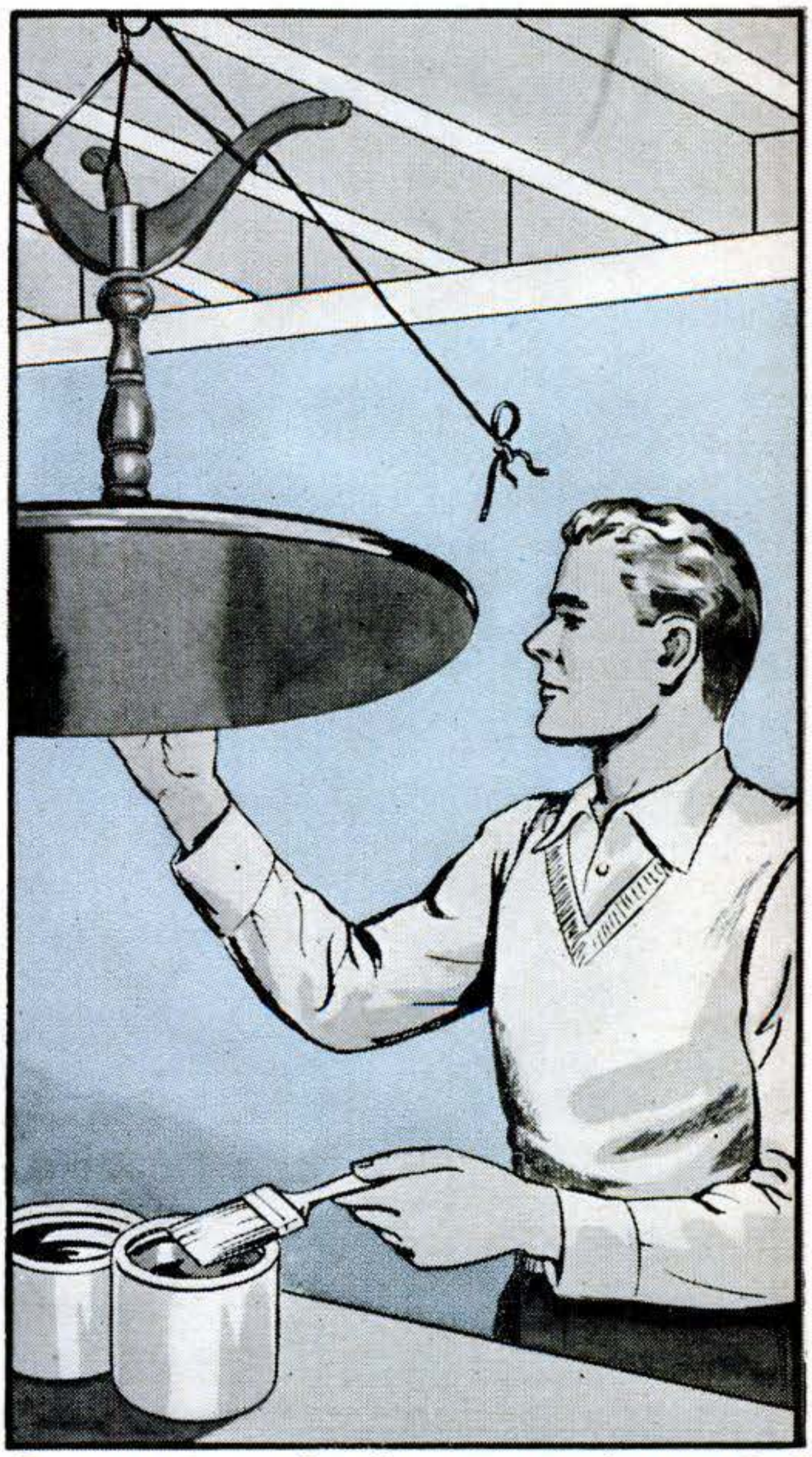
A spot of colored paint on the edge of each record can tell you at a glance what type of selection it is and make it easy to pick any kind of musical program from your collection.



Outdoor stairs that are located in deep shadow can be made safer if you brush a strip of aluminum paint along each tread and riser to catch whatever little light may be present.



Staples for framing pictures and similar non-electrical uses can be made from paper clips. Snip each clip near its center to make three staples. Cut at an angle to obtain sharp ends.



Dust specks won't collect on a newly varnished surface if it is suspended upside down to dry. Before trying this, though, clean the ceiling joists and give the dust ample time to settle.

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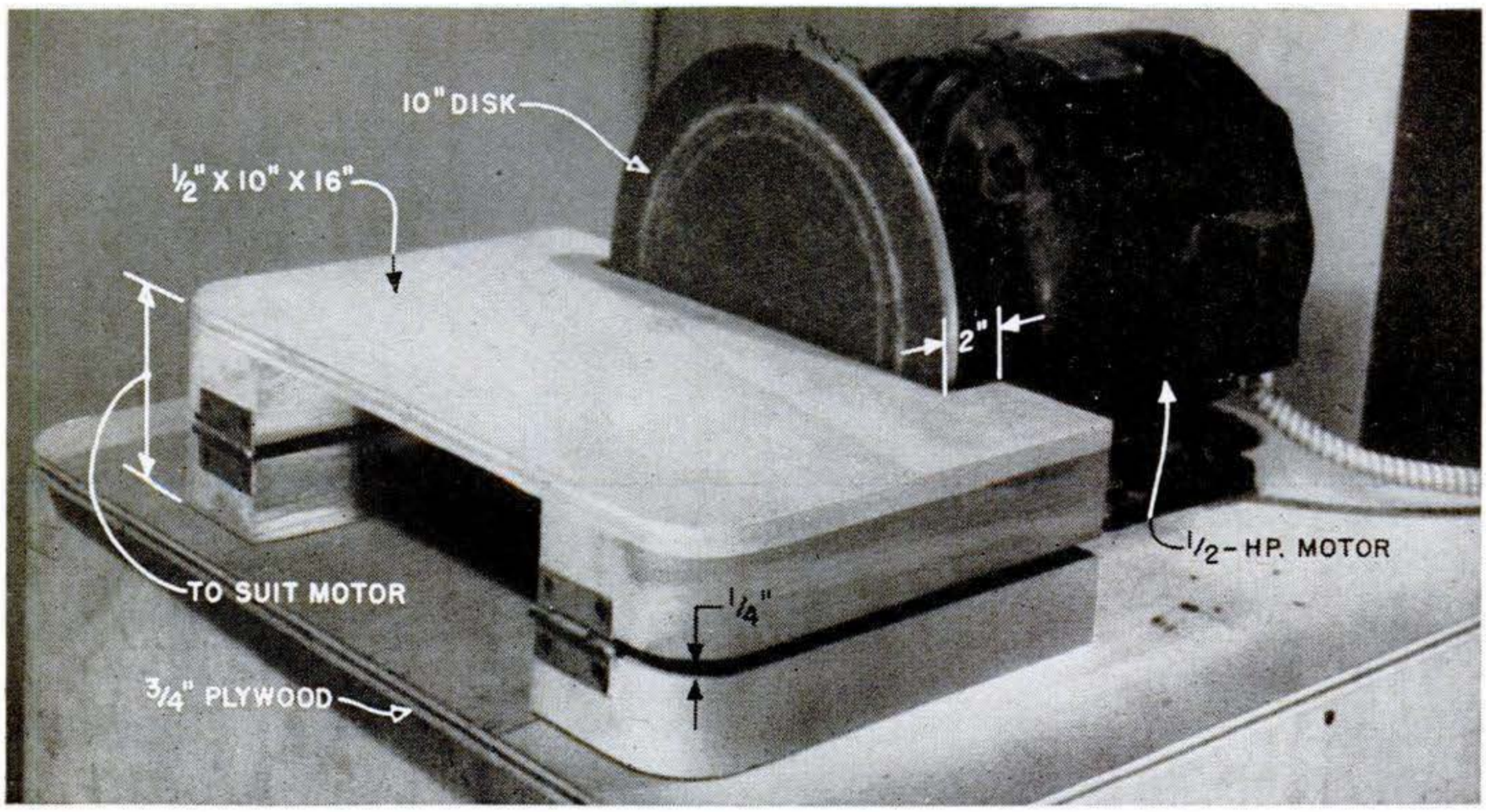


Whether it's sharpening shop pencils or shaping chair rockers, the disk sander saves time.

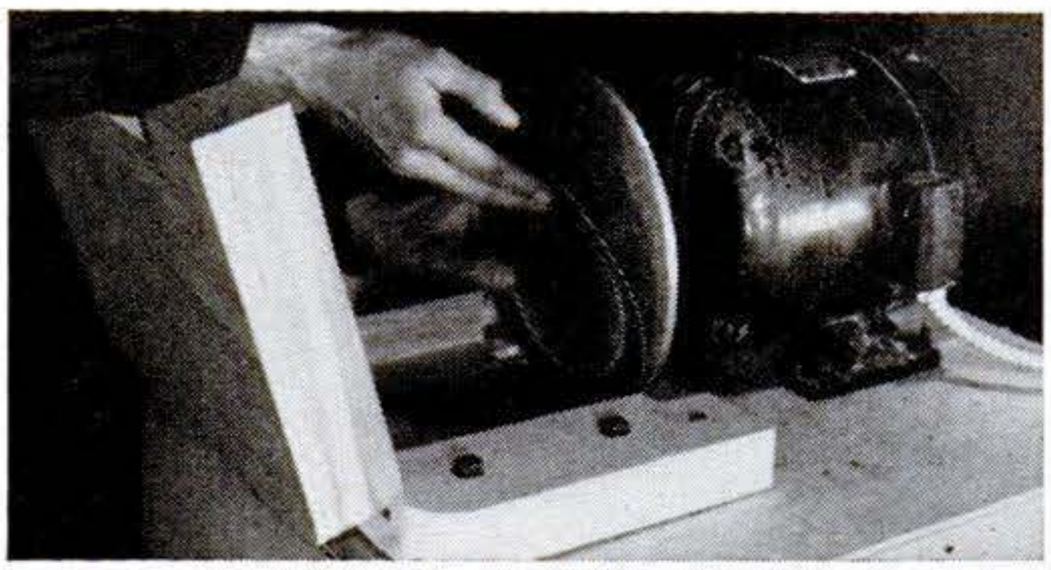
Hinged Table Speeds Sanding Jobs

DESIGNED for a production shop, this disk sander smooths rough stock and sands external curves to shape rapidly. Because of its wood construction, it is simple to build.

Both the motor and hinged table may be mounted on a base of ¾″ or heavier wood, a slot being cut to provide disk clearance and a place for attaching an exhaust unit if one is desired. A ⅓-hp. motor or better should be used to drive the 10″ disk, which can be bought, or cut from ¾″ plywood and bolted to a shaft flange. Adjust the height of the table to bring the center of the disk level with it. If the available stock makes the table too high, the motor may be blocked up the necessary distance.

In attaching the hinges, leave about a ¼″ gap between the blocks. Two wood screws, turned into the underside of the table directly over flat-headed nails driven into the base, provide adjustment for leveling the top square with the disk.—RICHARD HANSCOM.

Convex curves are a quick job. The table can be grooved for use of a miter gauge if desired.



Disks are replaced by lifting the top. A dust slot in the base also provides disk clearance.

Buffer Cut from Shoe Polisher

IF YOU have a hand power tool, a strip of sheepskin cut from a ten-cent shoe polisher and cemented around a grinding wheel accessory makes a first-class buffing wheel, suitable for polishing brass and any of the precious metals.—KENNETH MURRAY.

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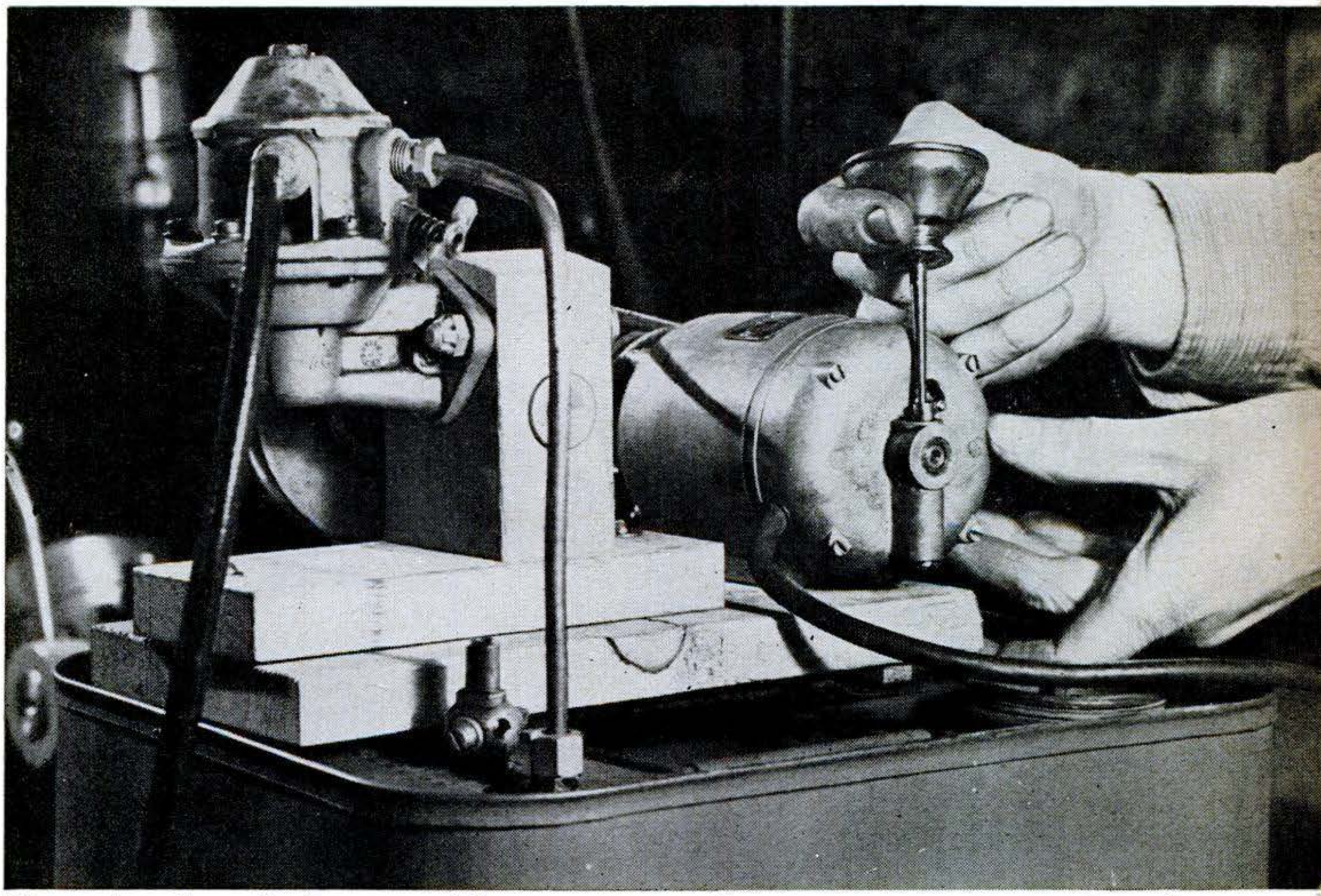
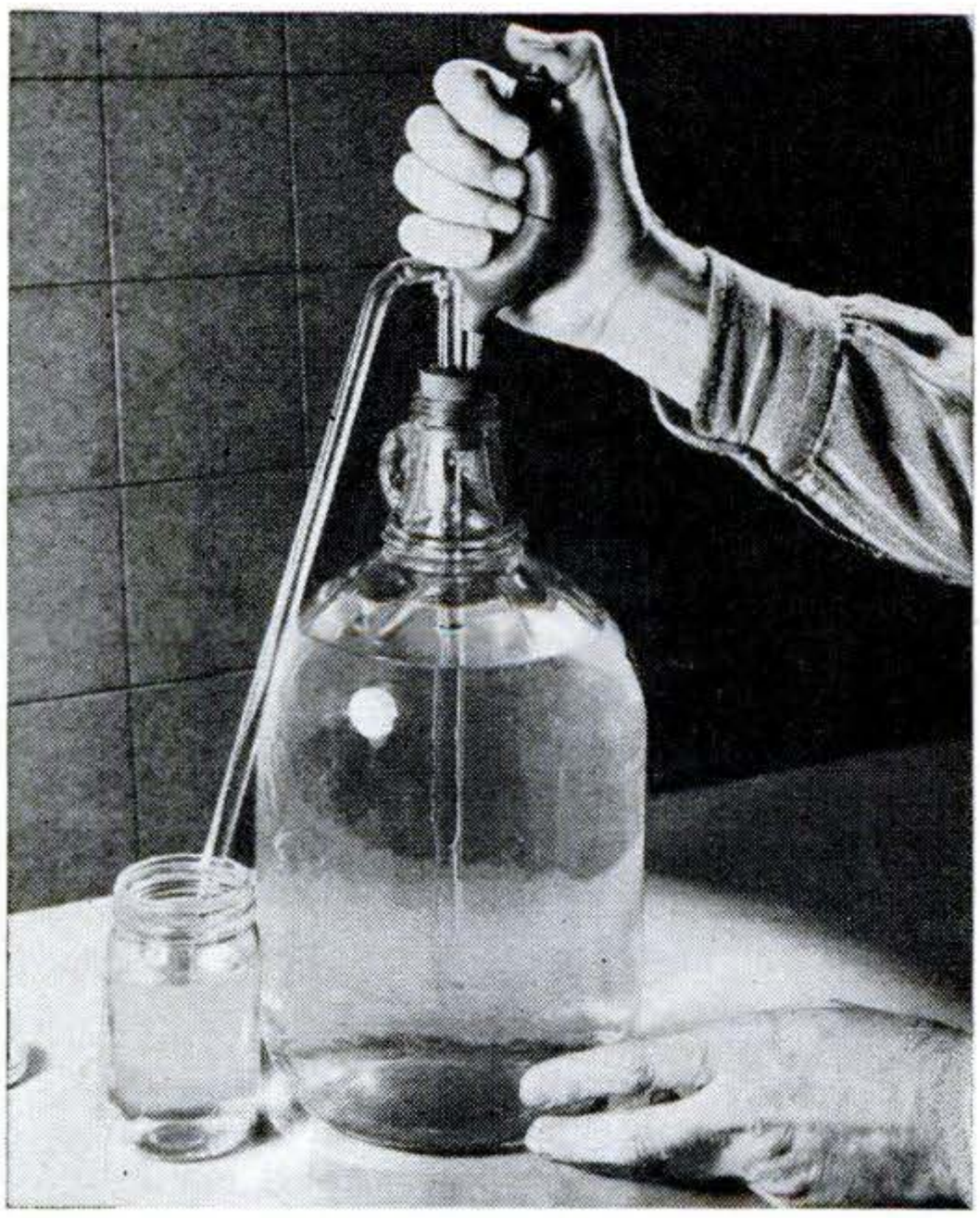


Mounted on the tank, this automobile gas pump was adapted to circulate cutting oil in a shop.

Let Pumps Do the Job



A bottle pump is operated by compressing the bulb while the thumb covers a hole in its end.

In your shop or your home, there are many ways they can aid you. Here are suggestions for making various types.

By Walter E. Burton and W. A. Conway

PUMPS in one form or another are adaptable to a wide variety of jobs. Around the home and farm, they can save a lot of labor in moving bulk liquids. In the shop, they'll provide a steady supply of tool coolant. In the laboratory and photo darkroom, they may transfer chemical solutions from one container to another. When water leaks into a cellar, they can pump it dry. To create a lively water display in table and garden fountains, and to aerate fish ponds, pumps will stay on the job 24 hours a day.

Simplest of all is a pump operated by a rubber bulb, an adaptation of the wash bottle seen in chemical laboratories. For this, you need only a two-hole stopper (rubber

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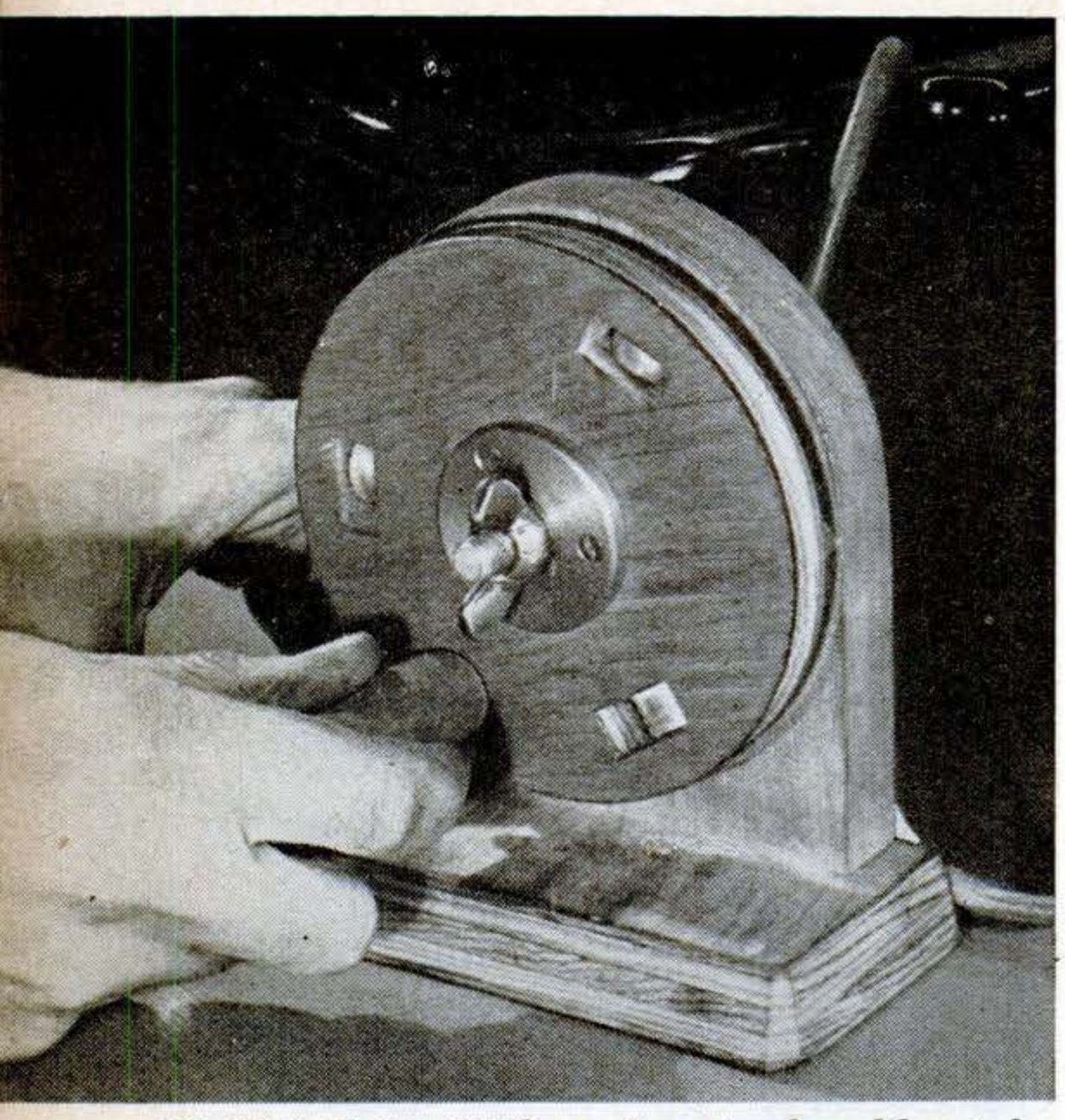
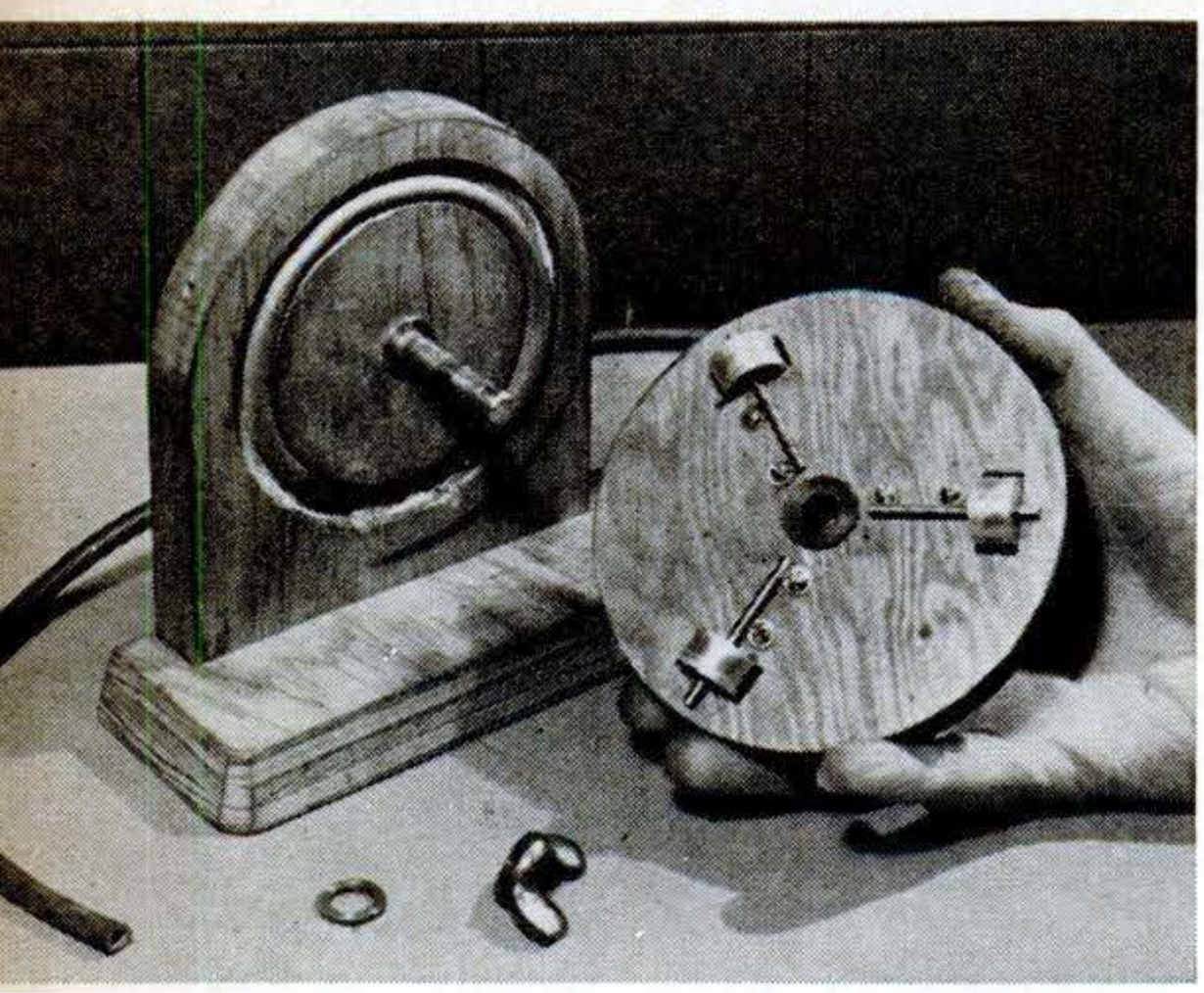


Fluid is "wiped" through a simple rubber-tube pump. Many uses may be found for such pumps.



All rollers must move freely around the groove. The rubber tubing is lubricated with talcum.

or cork saturated with paraffin), some glass tubing, and a rubber bulb open at both ends. Heat the middle of a short length of the tubing in a Bunsen flame, bend to about 45 deg., insert one end just through the stopper, and attach the bulb to the other. Bend a long piece of tubing to an angle of about 50 deg., and insert one leg through the stopper so the end almost reaches the bottom of the liquid.

To pump liquid from the bottle, compress the bulb while holding your thumb over the open end. Once the flow is started, the discharge tube will act as a siphon if the end is below the liquid level.

Another simple pump consists of a loop of rubber tubing, held in a fixed position, and several rollers mounted on an axis so as to move along the tubing, compressing the tubing and forcing liquid ahead of them as they go. Such pumps, made in one of several forms, are particularly useful in transferring corrosive liquids.

An improved type using the same principle but having considerable more flexibility is illustrated on this page. Here, the pressure of the rollers may be adjusted closely, a valuable feature when you want to use tubing of different sizes. When the pump is not in use, the pressure can be released, thus prolonging the life of the tubing. If roller pressure is released, the pump tube may operate as a siphon in some installations when once filled.

This pump has a ½″ wide rectangular groove ¼″ deep, centered on a 1¾″ radius; the rollers are ⅜″ wide and 11/16″ in diameter, and the rotor 4¾″ in diameter. Machined from aluminum alloy, the rollers rotate on ⅛″ brass rods in slots cut in the plywood rotor. An axle is fixed in a bearing plate, and the rotor is bushed to turn on it. The rotor may be turned by a hand crank, or a groove may be cut around its edge to receive a motor belt.

Lubricate the Tubing with Talcum

Since the tubing may have a tendency to "walk" through the pump, anchor the inlet end to the back of the pump body with adhesive tape at the point where it passes through into the groove. Also lubricate and protect the tubing that lies in the groove by applying talcum powder liberally. If the bearings are oiled, be careful to keep oil off the tubing. The operation of such pumps is sometimes improved by placing a circle of thin springy brass or steel between the rollers and tubing.

This pump may be used to transfer laboratory solutions to bottles from large tanks, pans, or sinks; to empty or fill aquariums; to circulate the liquid in a plating tank, and so on. If an oil-resistant synthetic rubber is used, the pump will handle oils and gasoline. Ordinary rubber is suitable for pumping oils for brief periods, but the tubing should be immediately flushed and thoroughly drained.

A third type of pump, useful around the

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garage and shop for transferring oils and other petroleum products, may be made from a standard gasoline pump. Such a unit, employing a Ford pump, is shown in the adjoining illustrations. This pump has a lever that moves a diaphragm back and forth. Therefore, the drive must impart a reciprocating action to the lever. This is accomplished by mounting a cam on a shaft driven by a pulley.

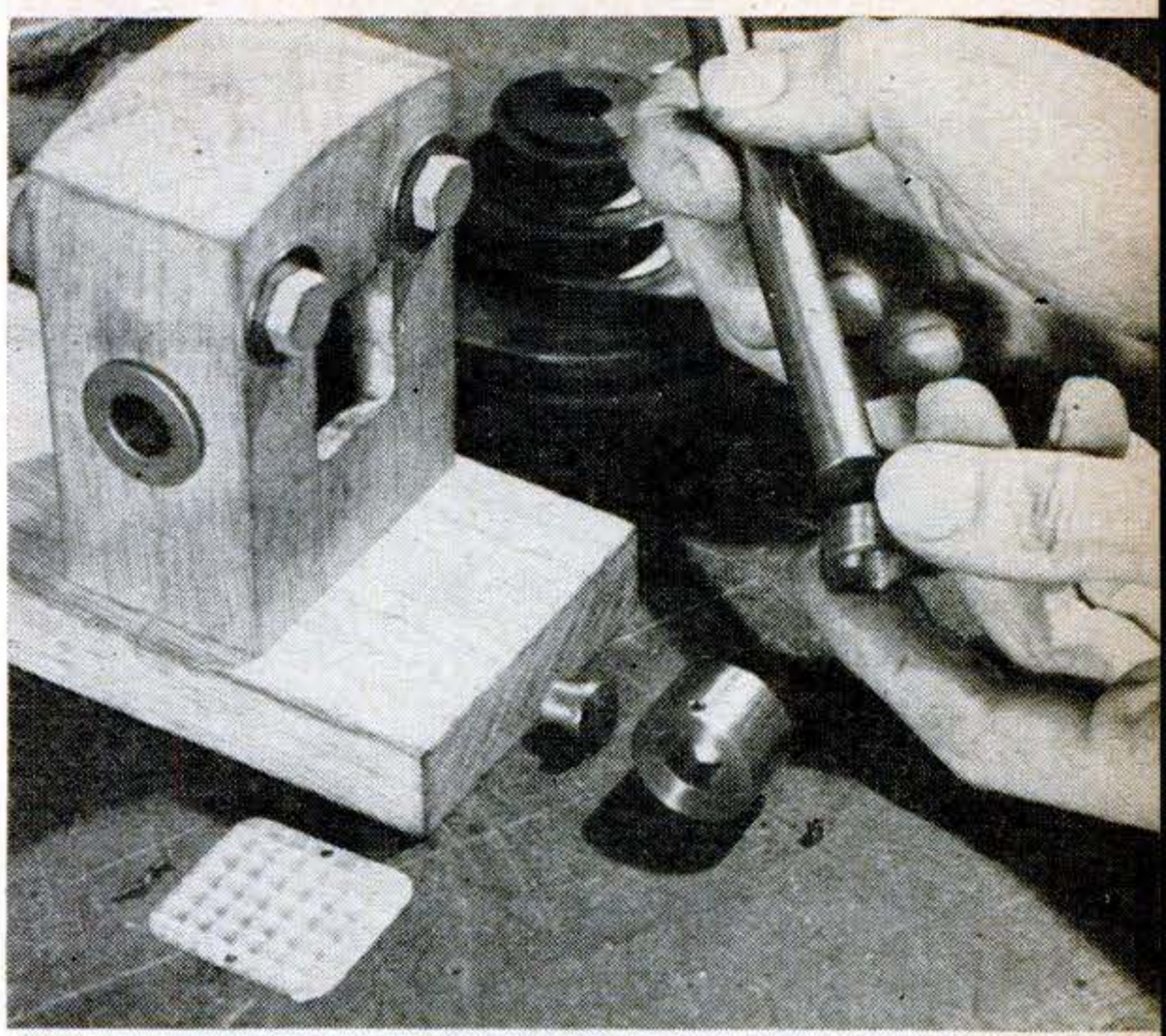
Two bolts hold the pump to a hardwood block, and the ½" shaft operates in two self-lubricating bronze bearings driven into holes bored into the wood. The cam, machined from cold-rolled or tool steel, is held by a small setscrew near one end. A spacer collar between cam and bearing at the pulley end of the shaft is machined from cold-rolled stock, or may be part of the cam. The cam has an offset of 1/16", measured between centers of the outer diameter and its shaft hole. This imparts a ⅛" stroke to the end of the pump arm. Lubricate the cam with heavy oil or grease. A sheet-metal plate keeps the lubricant in and dirt out.

High Speed Gives Steadier Stream

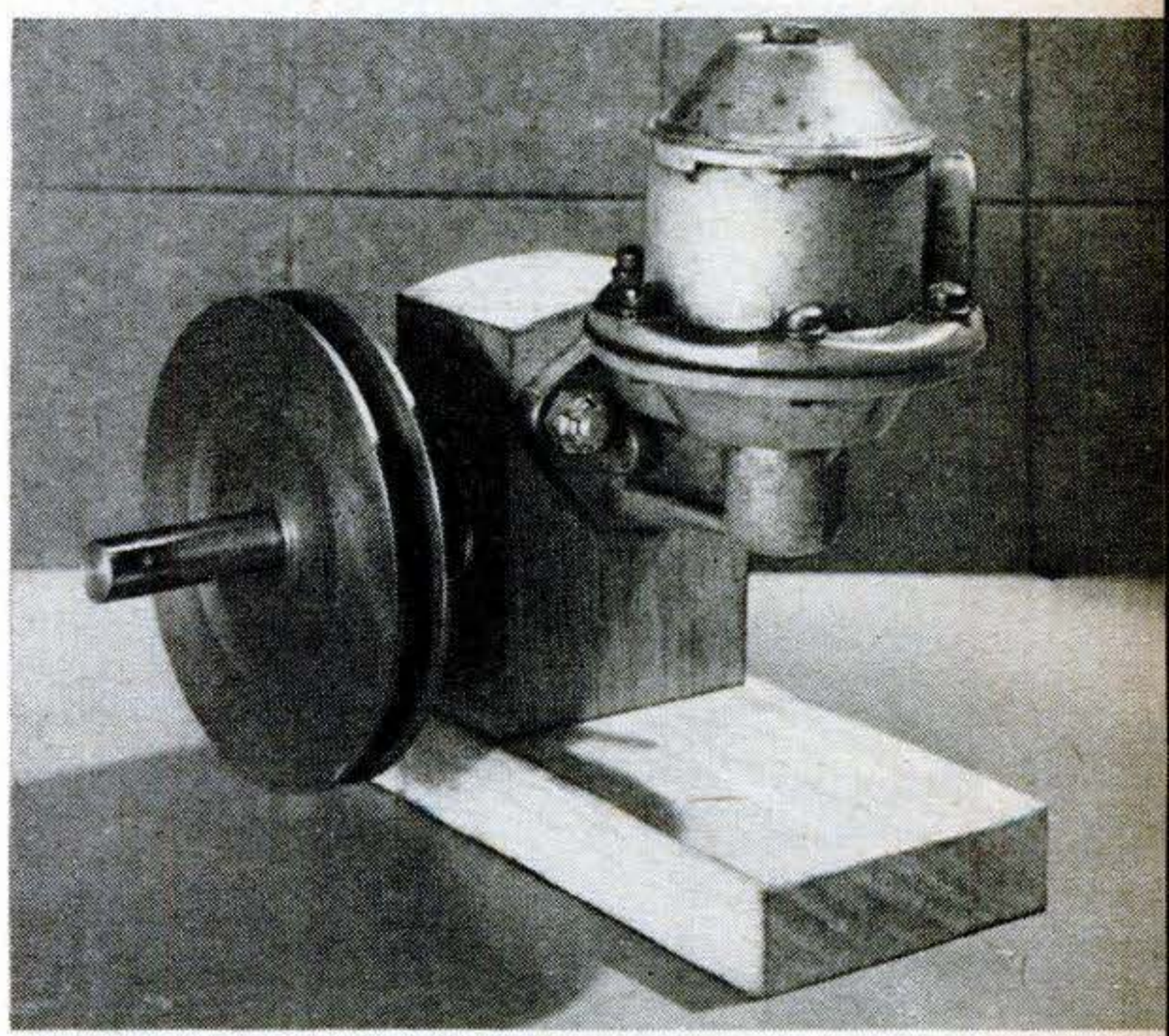
A 1/20 or 1/30 hp. motor will provide adequate power for most uses. The pump may be operated at various speeds, but the stream is steadier and more powerful at the higher rates. When operated very slowly with a geared-down motor, the pump may be used to aerate an aquarium. It will also serve for pumping coolants for a lathe, milling machine, drill press, or other machine tool provided there are suitable filters or settling tanks to keep solid particles out of its valves. Normally, small amounts of solids are trapped by a screen built into the pump. This may be reached by taking off the cap on top of the pump.

For circulating cutting oil or other coolants, a better arrangement is to mount a vane-type automobile oil pump so it is immersed in the oil or at least has its inlet port below the surface. During war-production days, one machine shop used such a setup with a drill press, the pump being immersed in cutting fluid in a pan below the table that served both as a reservoir and a means of catching fluid that dripped from the table. Mounted in a corner of the pan, the pump was surrounded by a fine wire screen to keep chips out of it. Since a portion of the housing of this type of pump is cylindrical, it can be easily mounted in a hole.

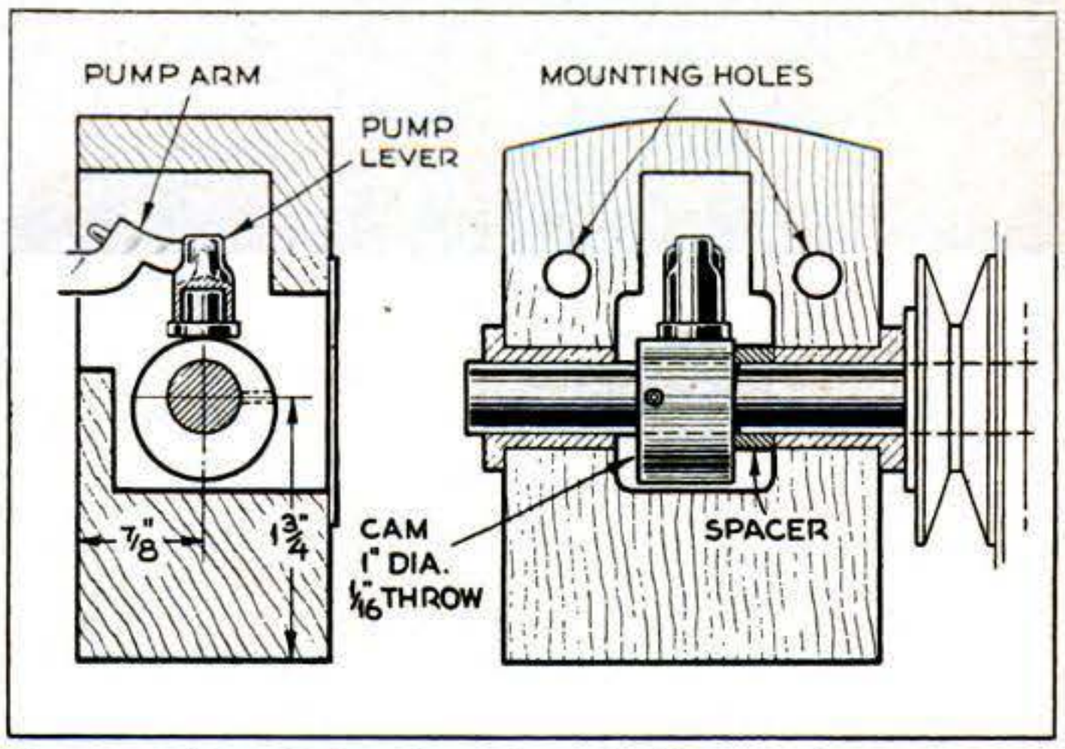
By modifying the pan design or by using



Install a cam to impart a reciprocating action if you want to use a diaphragm-type gas pump.



Mount the pump on a hardwood upright. Cut as below to take the shaft and cam assembly.



Bronze bearings for the shaft are driven into bored holes. Attach the cam with a setscrew.

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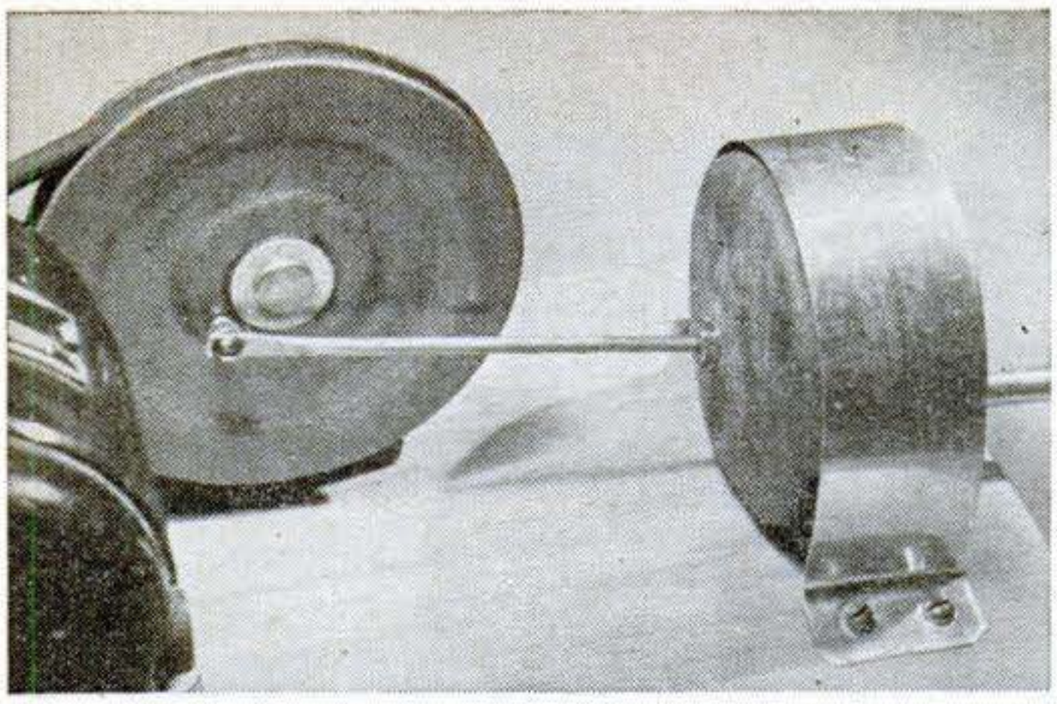
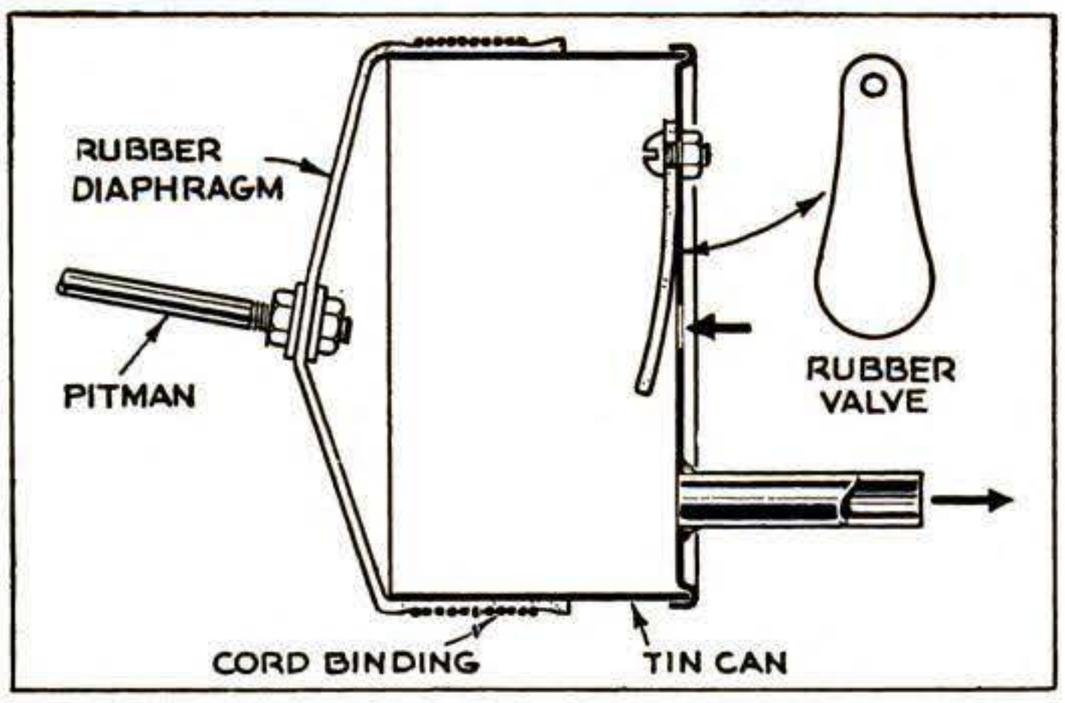
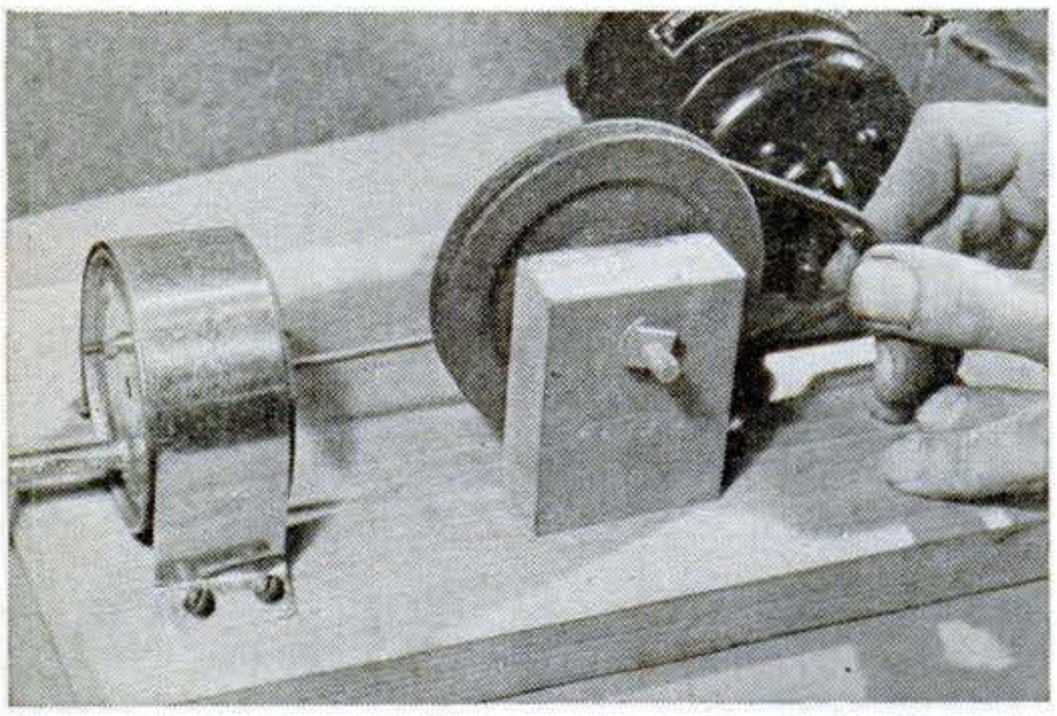


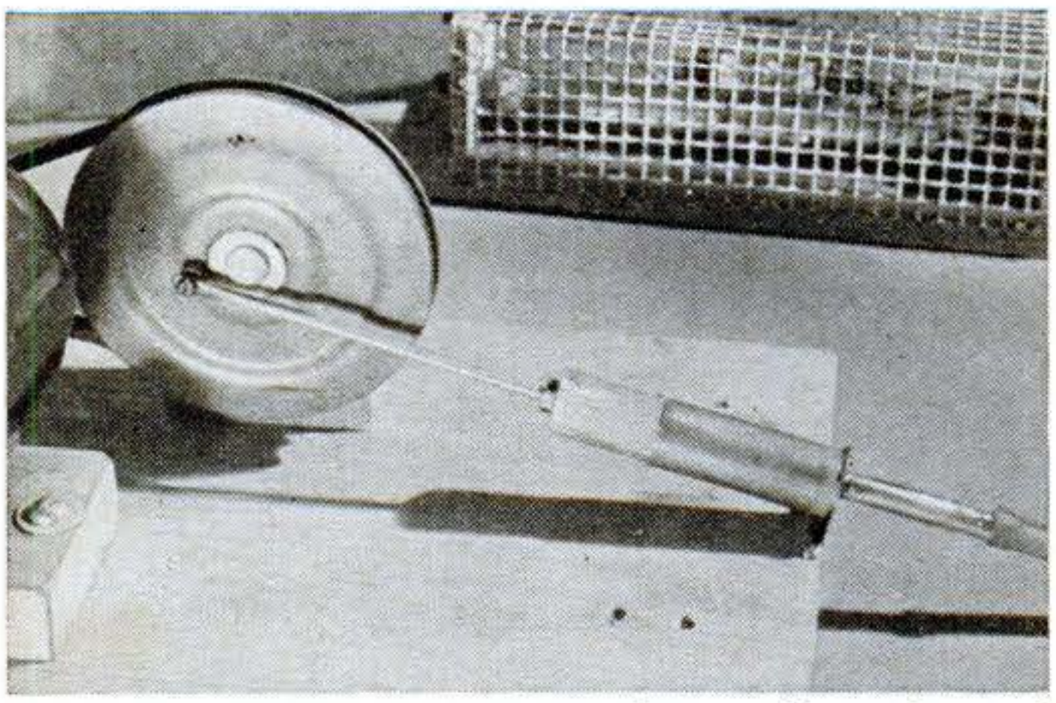
A rubber-diaphragm pump may be used to aerate aquariums. One stroke a second is ideal.



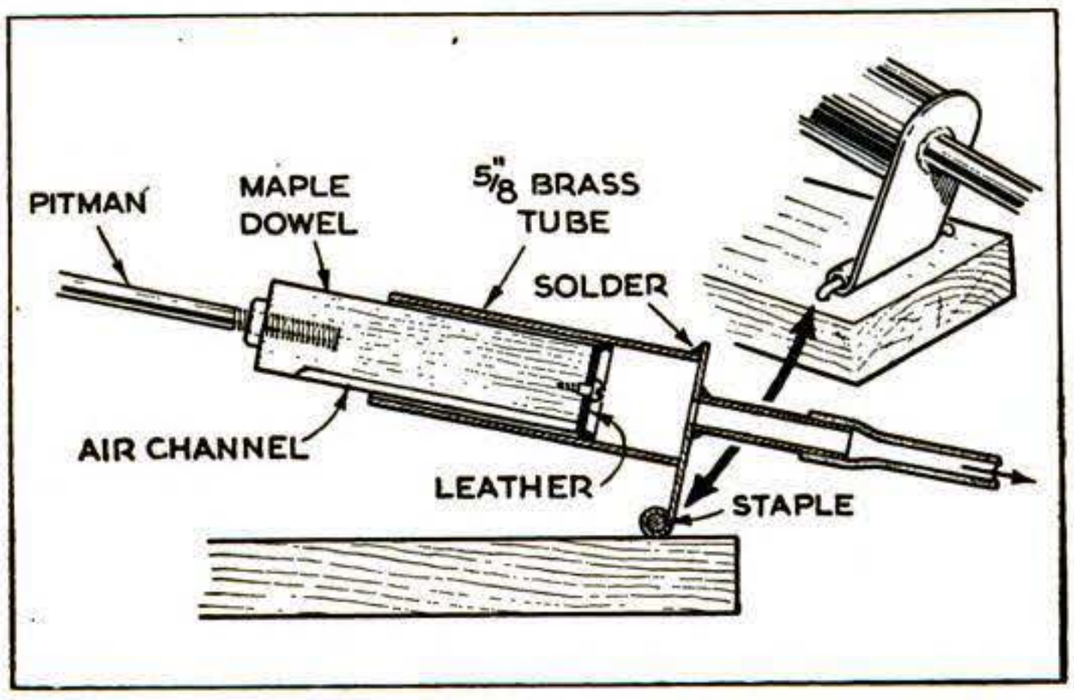
Drill two holes in the can bottom. Cover one with the valve and solder tubing to the other.



Speed is reduced by running the belt directly on the motor shaft. A larger pulley would help.



A piston and cylinder may be used in place of the diaphragm pump. The drive is the same.



Air is pumped on the power stroke by a leather disk. Here the stroke is 1" and the bore 9/16".

a separate tank, a similar arrangement may be used to pump coolant to a lathe or milling machine (PSM, Aug. '44, p. 194).

Aquariums require aerating to freshen the water. Two types of reciprocating pumps that do the job well are seen here. Such pumps discharge their air through small holes in a metal tube on the aquarium bottom. These pumps are also fine for agitating electroplating solutions (PSM, Dec. '47, p. 210).

Diaphragm or Piston Moves Air

One type consists of a rubber diaphragm that is oscillated by a crank arm. In the other, the diaphragm unit is replaced by a simple cylinder and piston, the driving mechanism remaining the same. Any small, quiet-running motor that has sufficient power may be used, a rubber vacuum-cleaner belt connecting the motor to a large pulley mounted on a wooden block. In this case, the 3½" pulley is a war surplus item. It has a ball-bearing hub that is secured to the wooden block by a ¼" bolt. Experience with the pump indicates that a larger pulley, say one 5" or 6" in diameter, would be better because of the slower possible speed.

A crank arm, or pitman, may be made from ⅛" brass or steel rod. Thread one end for a standard nut such as a 6-32, flatten the other end, and drill a hole in it to receive a 4-36 or larger bolt that engages a threaded hole near the pulley hub. Thread the hole only part way through so the bolt will jam tightly in it. Use a spacer to keep the crank arm clear of the shaft end.

The drawings illustrate construction of the diaphragm and piston units. Use a strip of tin plate and wood screws to mount the diaphragm unit on the base, locating it so the crank will be at the midway position on the pulley when the diaphragm is un-

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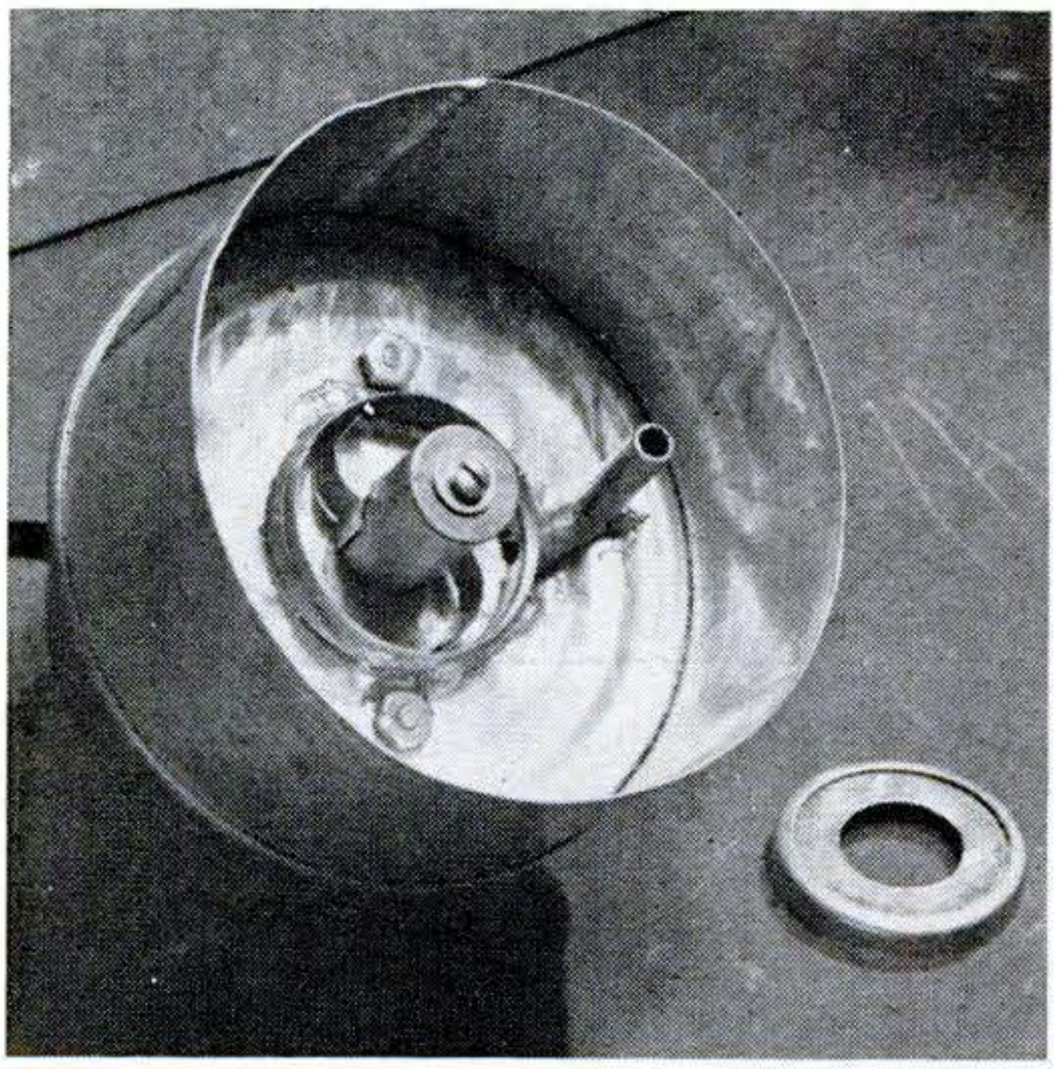
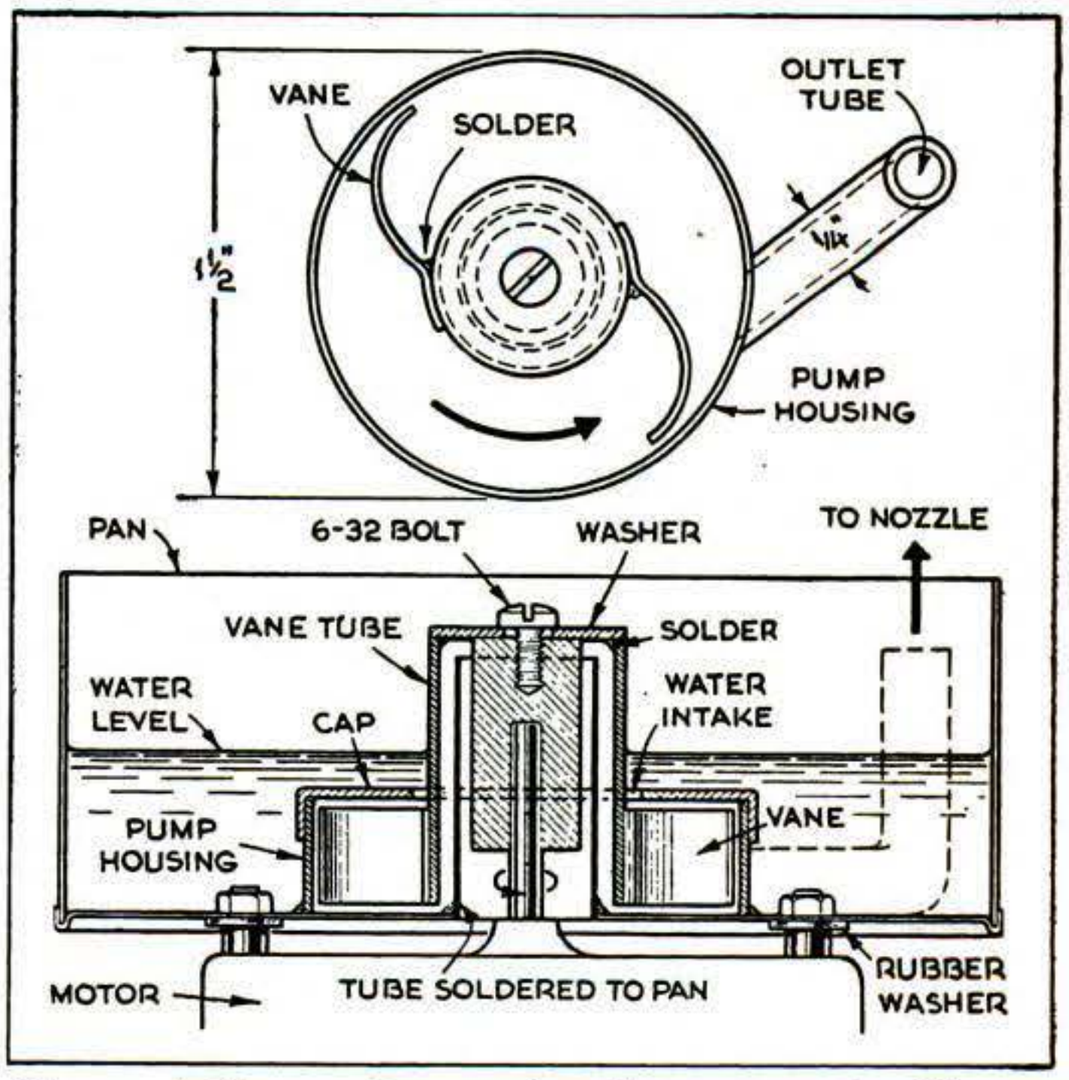


A tin can serves as a reservoir for this small fountain pump. Watertight joints are essential.



Conceal the motor under the reservoir. Run a length of rubber tubing up to the sprayhead.

flexed. For an aquarium, the pump should be operated at about one stroke per second. On the inner end of the dowel in the piston unit, fasten a cup-shaped disk of soft leather with a single small screw. Thus, when the piston is pushed into the cylinder, the disk drives air ahead of it. When the piston is withdrawn, it permits a fresh charge of air to enter. For best results, you should keep the leather lightly oiled.

A toy steam engine driven by an electric motor belted to its flywheel also makes a practical aquarium pump. Connect the tube to the steam-inlet port. Similarly, a model gasoline engine could be used as a compressor, the air-outlet line being connected to the spark-plug hole.

Centrifugal Pump Operates Fountain

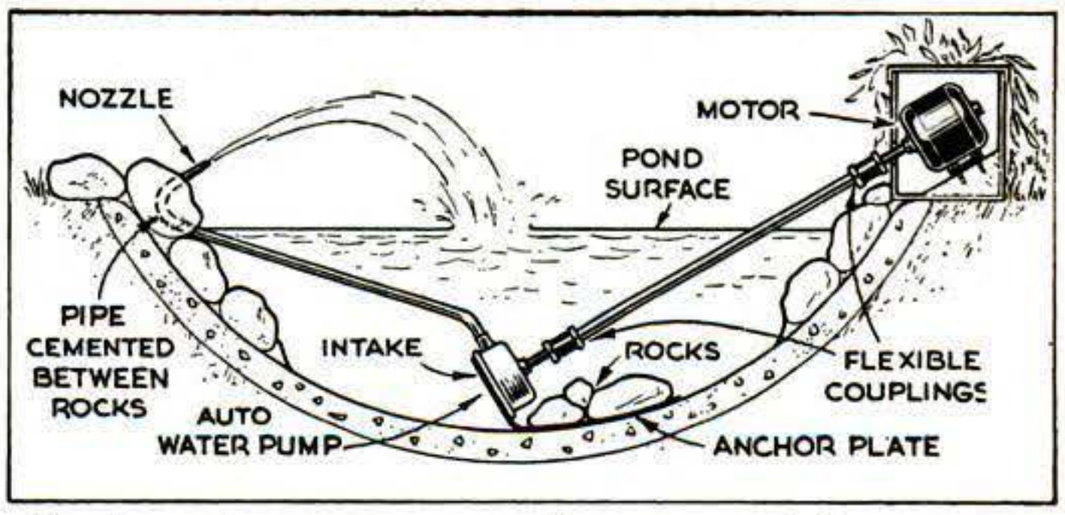
A fountain projecting a stream of water a few inches into the air is an eye-engaging centerpiece for a table. A centrifugal pump to power such a fountain is shown above, the small induction motor being concealed under the base.

To prevent water from running down on the motor, a vertical tube is soldered to a central hole in the pan. The central sleeve or arbor should be a tight push fit on the shaft. This sleeve, the washer at the top, and the brass tube bearing the pump vanes constitute the rotor. Note that the hole in the washer is large enough to permit the vane tube to be adjusted for clearance.

The housing in which the vanes rotate was made in this case from a tin box 1½" in diameter. Cut to a height of ⅜", the box was soldered watertight to the pan bottom. The box lid, with a hole cut in its center, acts as the top part of the housing, its outer rim being a close fit. There should be enough clearance between the lid and vane tube for the water to enter the pump, say ⅛" all around.

Rotor vanes may be made of sheet brass or other non-rusting material. In this case, they measure, when straight, 5/16" by ¾", and have ⅛" of their length bent at an angle for soldering to the ⅝" brass vane tube.

Driven by an electric motor, a centrifugal automobile water pump is excellent for transferring considerable volumes of water. One application is as a sump pump for draining a wet basement. For a sump installation, the motor should be a ball-bearing type that will operate with its shaft vertical. Other applications could be circulation of water in a hot-water heating system, or operation of a lily-pool or wall fountain. END.



Garden fountains may be operated by an auto water pump. Place a screen around the intake.

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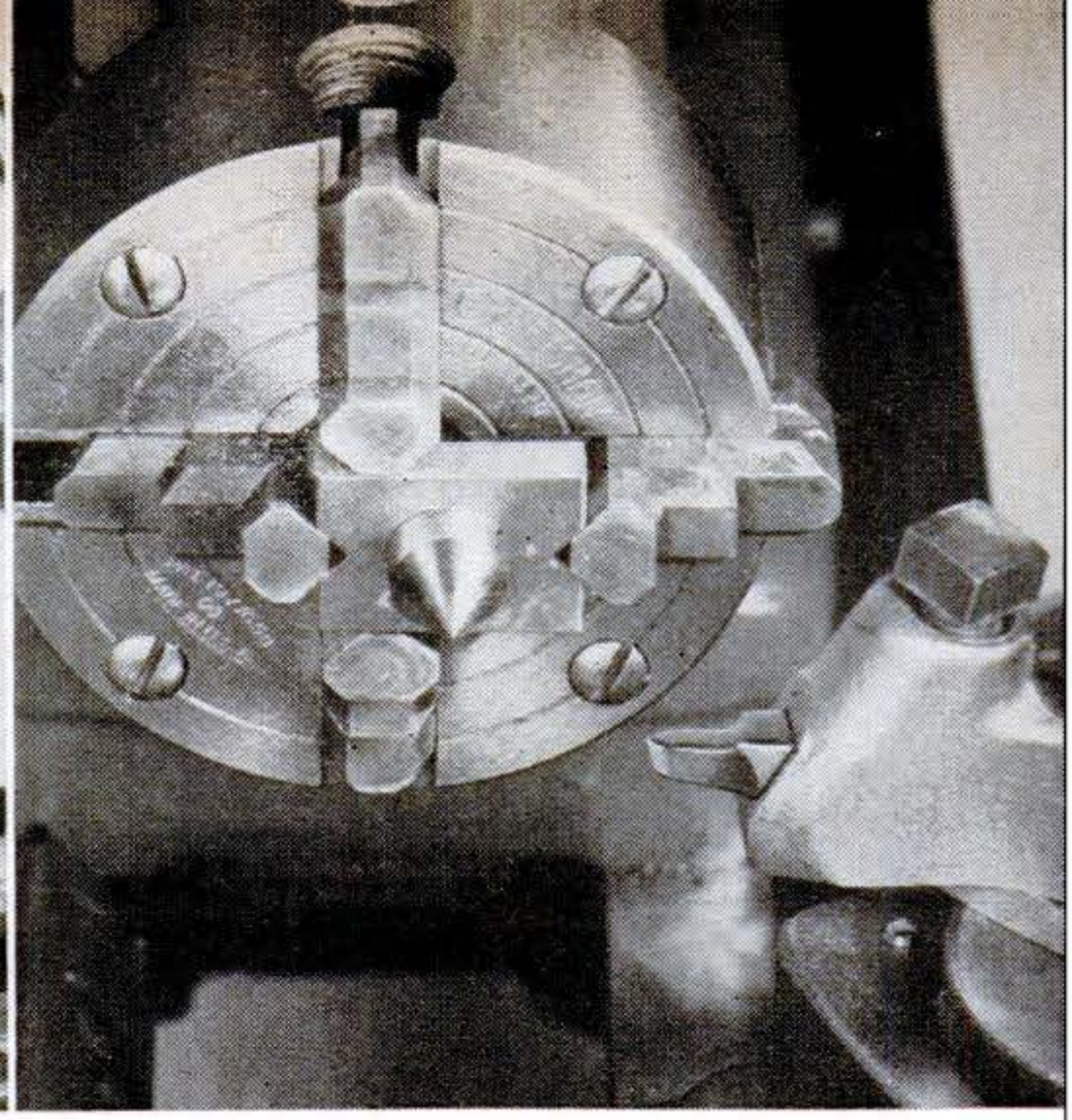
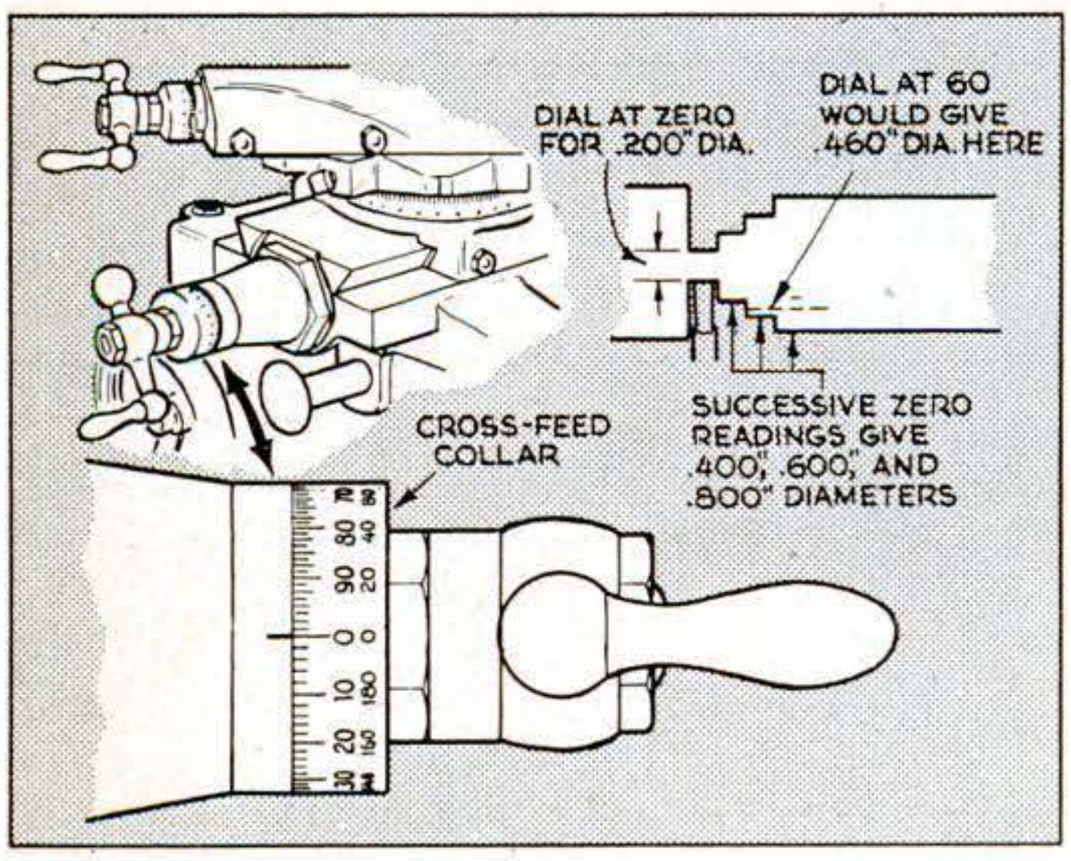


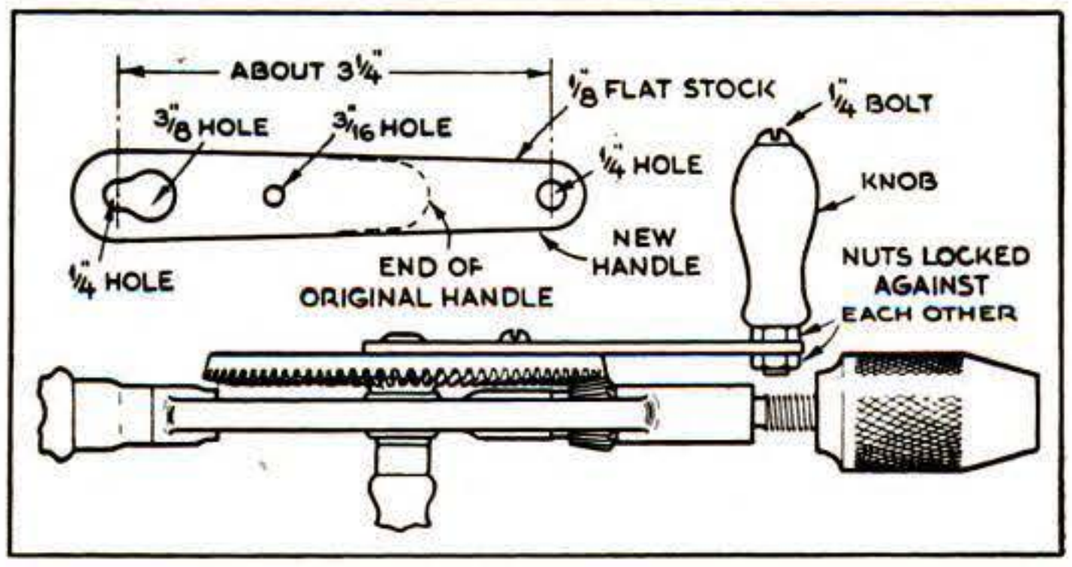
NEW SHOP IDEAS

Taper Turning Is Simplified. The bother of realigning a set-over tailstock after taper turning is eliminated with this handy device. It consists of a stub 60-deg. center pressed into a small plate of 3/16" stock that can be held in the 4-jaw chuck. With the latter mounted on the tailstock, the degree of set-over and hence of taper is simply a matter of careful chuck adjustment.—H. L. PHILLIPS.



Dial Mikes Diameters. It's often awkward to measure narrow grooves or shoulders with a micrometer. I now read these diameters off the lathe cross-feed collar, using an extra set of figures etched on it. These run oppositely to the original, and are twice the value. Instead of etching the dial, you can attach adhesive tape outside the old readings, with the new ones penned on it.

Set up a combined turning and cut-off tool and turn a scrap piece down to nearly .200". Leave the cross-feed handle at exactly zero while you use the compound feed to bring the work to precisely .200", as measured by a micrometer. This sets the tool to show any desired diameter. For any under .200", the new collar may be read directly; for larger diameters, each successive zero adds .200".—FRED N. SCHWEND.



Improving Hand Drill. The average hand drill has insufficient torque when the drill encounters stiff resistance, as when breaking through metal. I made a special longer handle for my drill and now find that I have plenty of power for most jobs. To make a replacement handle, remove the old one, trace its outline on ⅛" flat stock, extend it as desired, and saw out. Make sure the new handle will clear the chuck and drill body. Save the old crank in your toolbox for use in cramped quarters.

Dispersing Abrasives. The craftsman who has occasion to use the finer grades of aluminum oxide or silicon carbide abrasives often finds it difficult to spread them evenly over a lap. Try keeping them in tightly corked bottles to which alcohol has been added. When the abrasive is needed, shake the bottle and spread a few drops on the lap. The alcohol evaporates rapidly, leaving a thin and evenly distributed deposit.—RALPH MCCLUNG.

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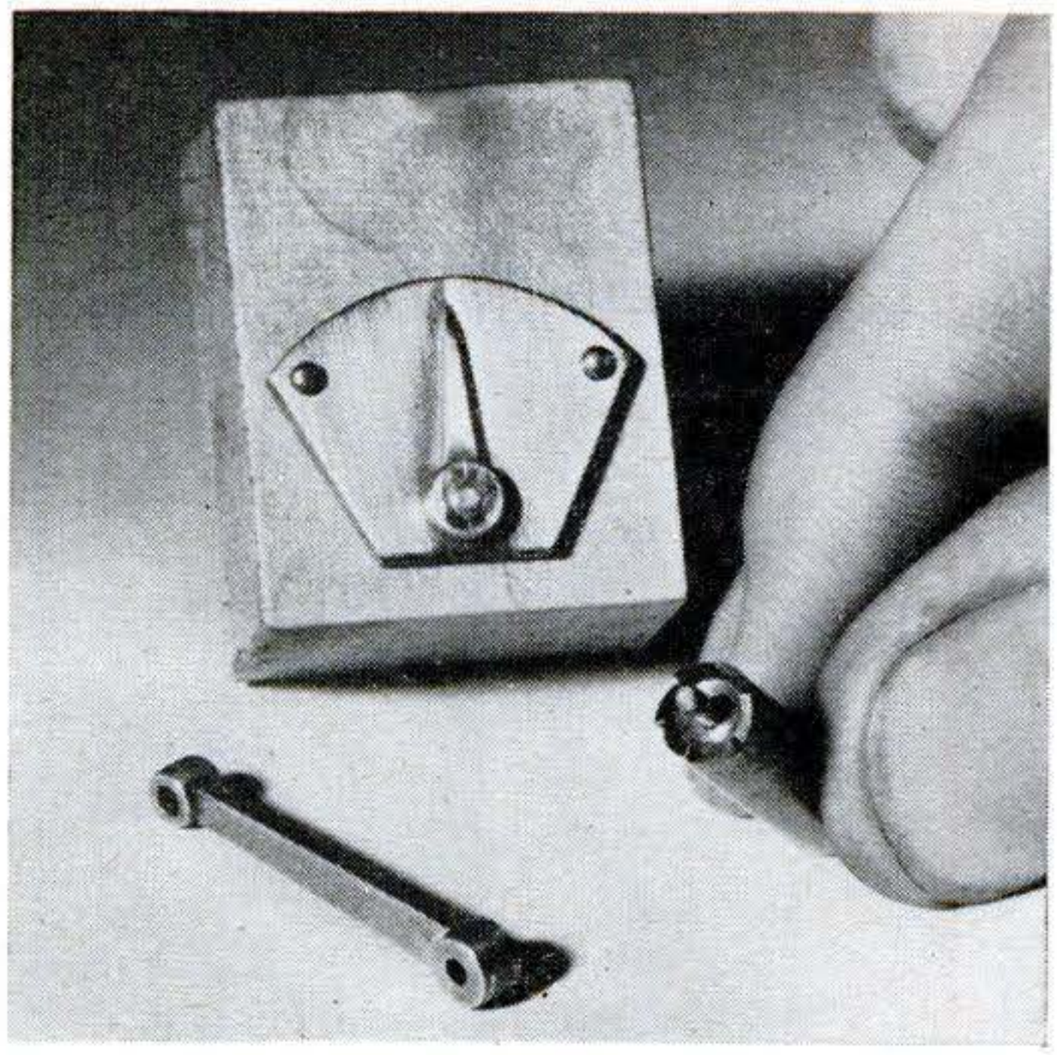
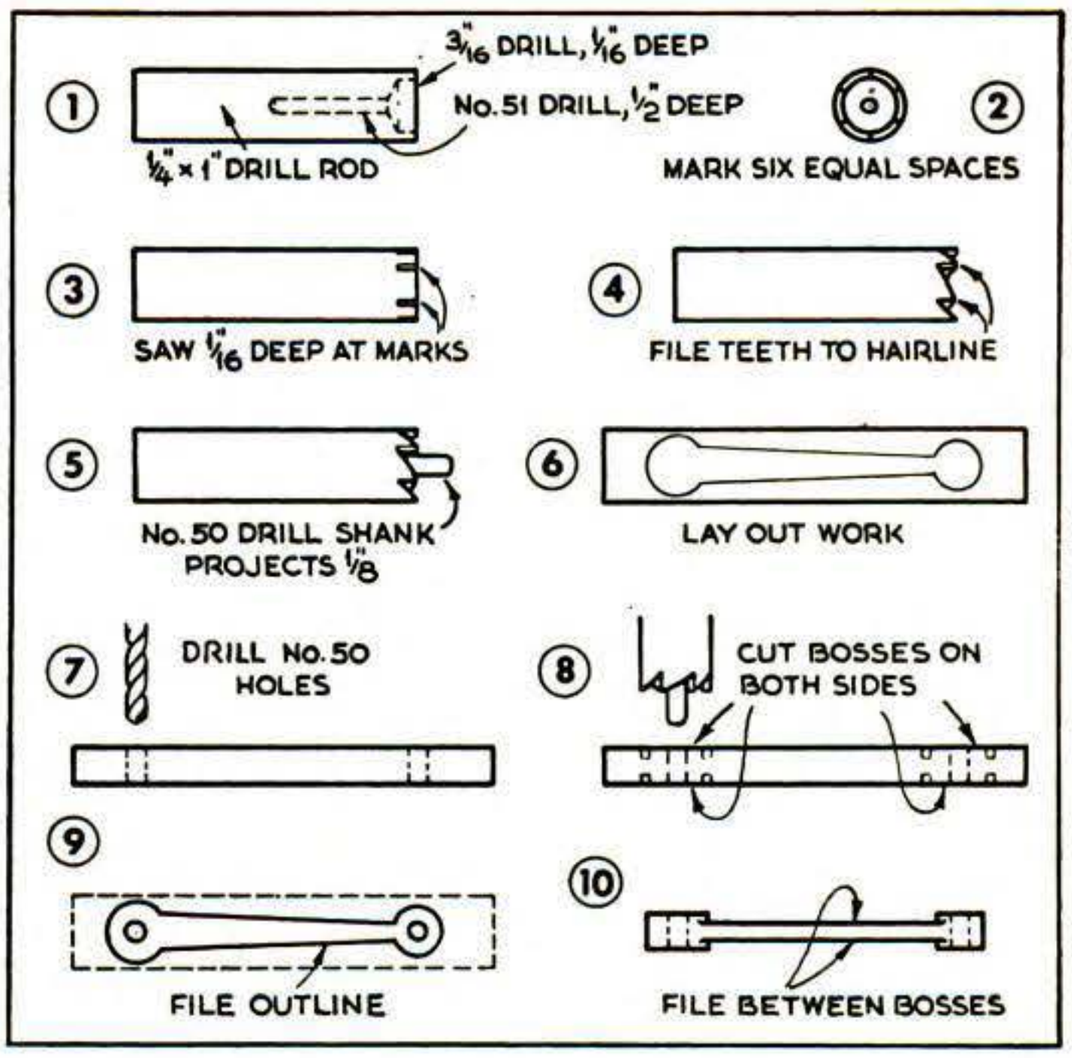
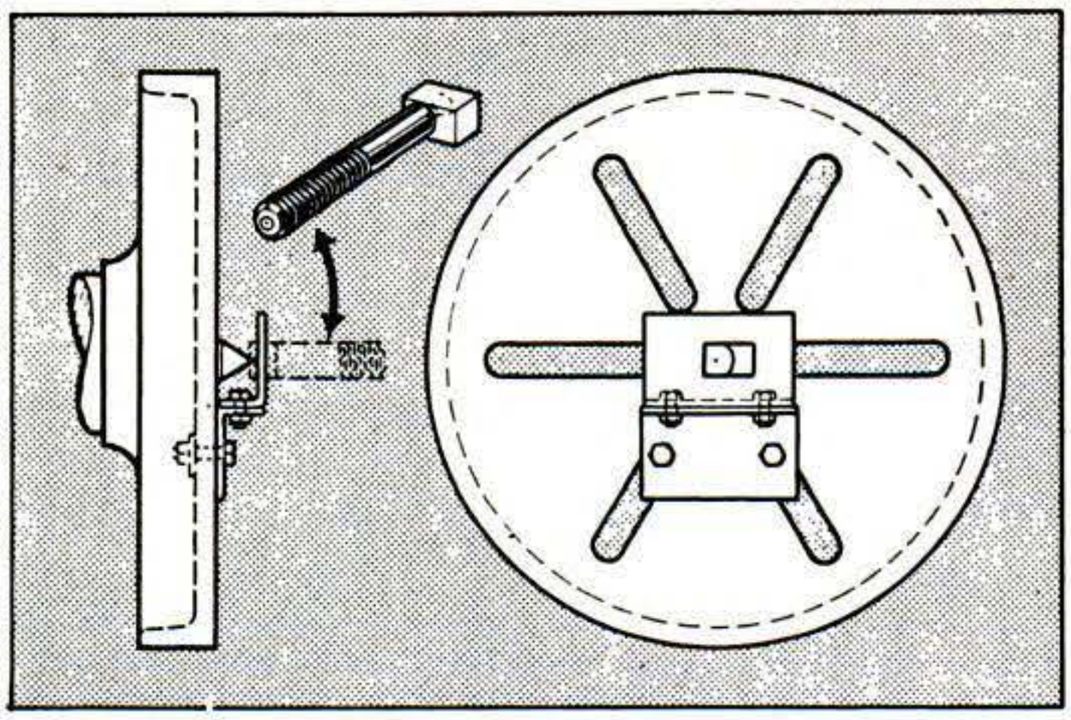
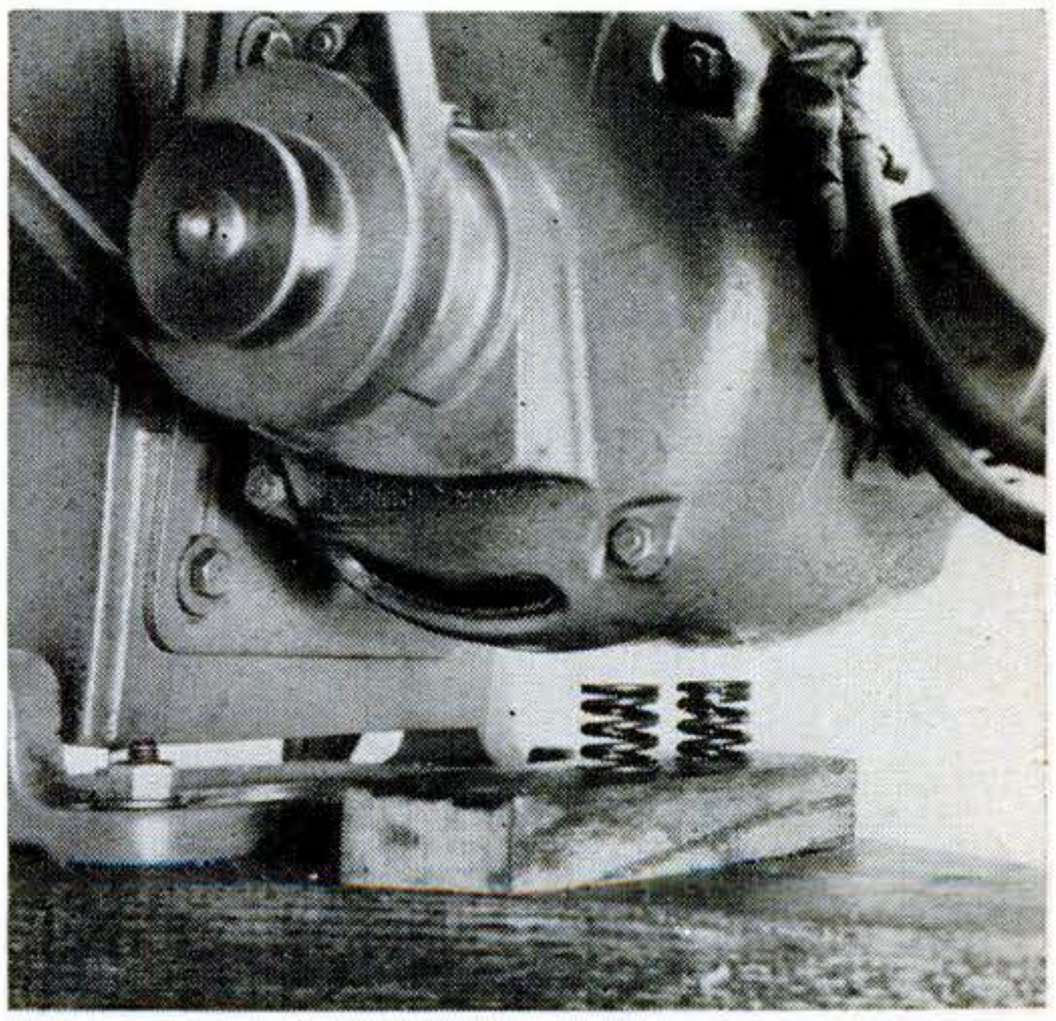




Tool Cuts Bosses. One of the toughest details to reproduce in making models of locomotives and other machinery is the boss at the end of a connecting rod or wheel. The little homemade cutter held in the fingers above, designed for use in lathe or drill press, will turn out very realistic con rods or wheels in short order. The sequence of construction is shown in Figs. 1 through 5. Harden by heating bright red and quenching, and temper by heating the shank gently until a straw color moves to the base of the teeth, and then requenching. The steps showing how to make a small con rod are detailed in Figs. 6 through 10. The through holes can of course be redrilled larger after the bosses have been formed. If you make yourself just one such cutter, be sure the boss diameter suits the scale in which you are working—H. R. Pfister.



Special Dog Drives Work. We had to make a number of bolts with hook-type heads, turning them from flat bar stock that was centerdrilled off center at both ends to provide the overhang. To drive them on the lathe we devised a pair of angle brackets bolted together as shown, with an oblong hole filed in one to take the work. A lathe dog of this type has the merit of allowing the cutting tool to get within 1/8" or so of the driven end, and turn a clean, sharp bolthead shoulder. Similar special driving brackets could be made with holes designed for use with square or hex stock.—G. Taylor.



Springs Cushion Motor. With a lathe motor placed on a pivoted mount, throwing the countershaft-release lever to the power-off position let the motor drop with an annoying thump. A pair of valve springs from a junked car stopped the noise and saved the motor from possible harm. The springs fit into blind holes in a wood block underneath, the holes being bored to a size that is a light press fit for the springs.

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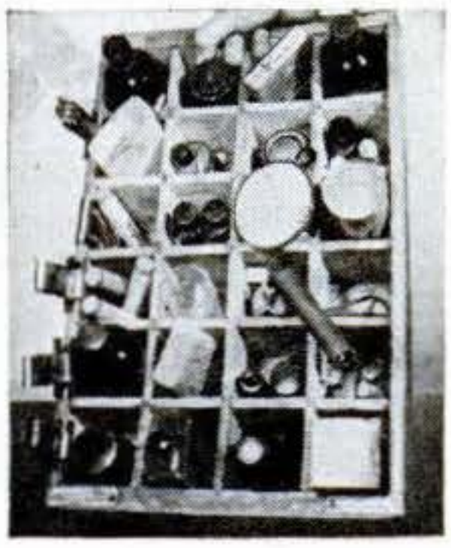
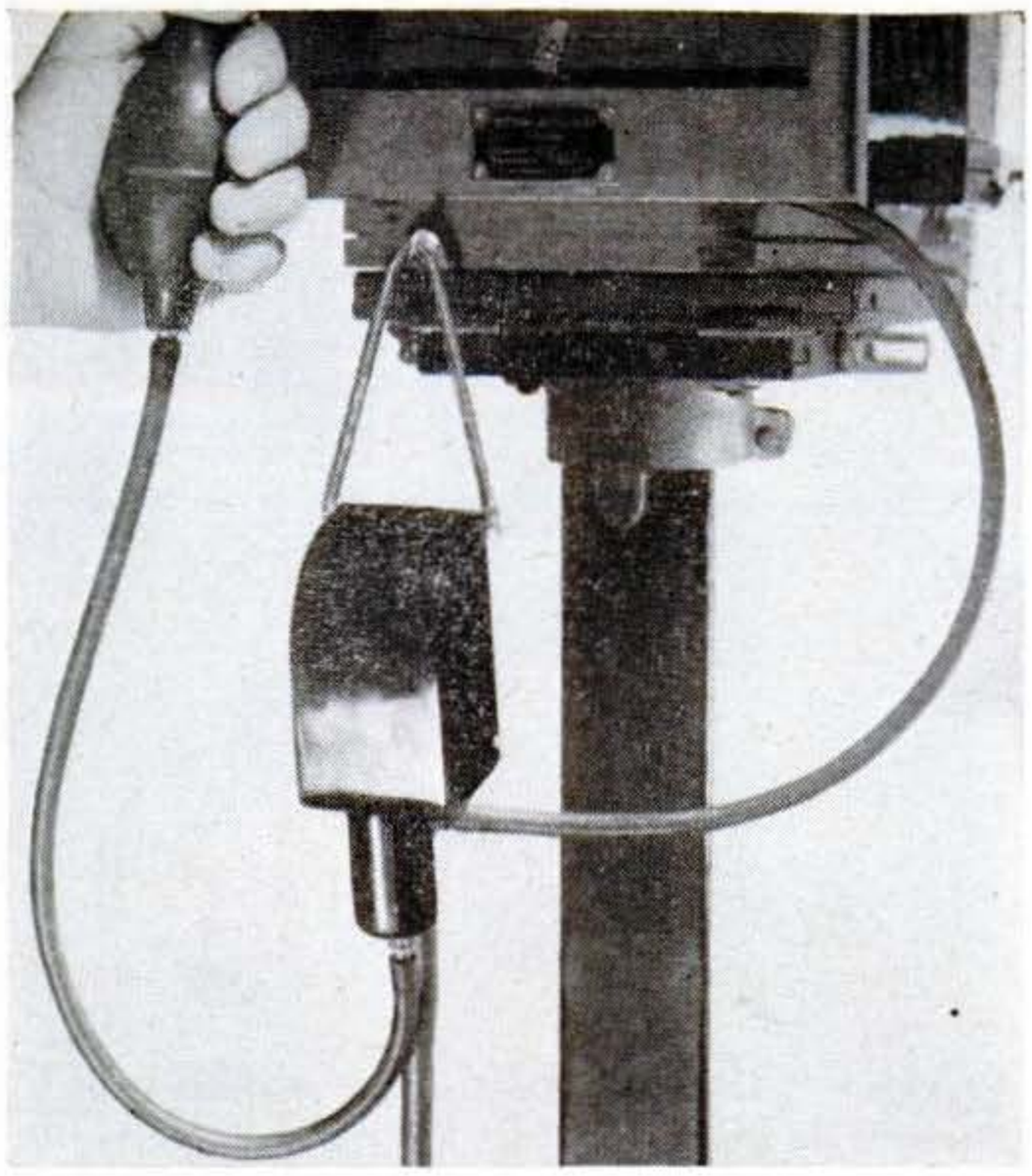
PHOTO IDEAS AND EQUIPMENT

Wax Frees Holders. If your sheet-film holders are difficult to slide in and out because they stick, apply a very thin coating of wax along the edges and they then will move with ease. The same treatment will overcome the tendency of metal film-pack adapters to bind.—W. MERRILL.

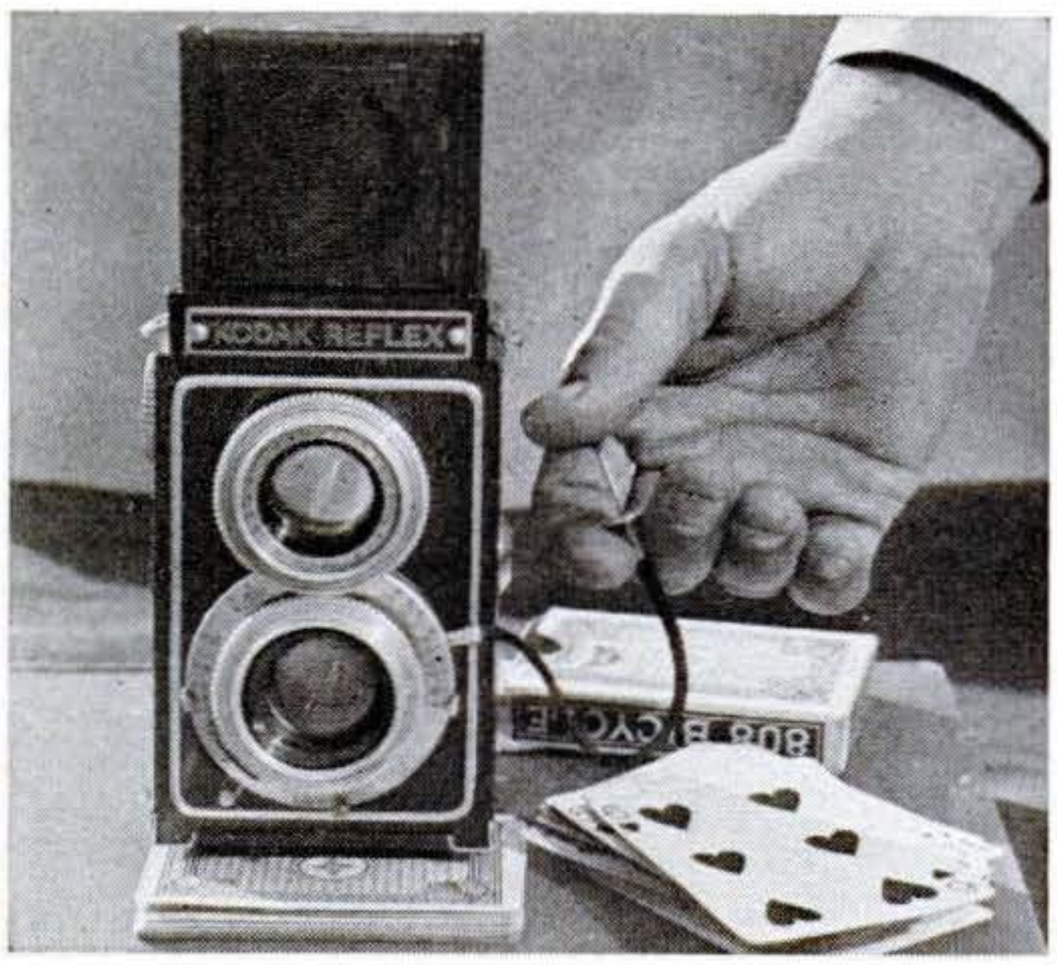


Storage Rack. A partitioned bottle case of the type used to deliver beverages will serve as a handy rack in the darkroom for storage of various small items of photographic equipment. It also may be used as a means of transporting such equipment to the kitchen or other temporary darkroom, the hand openings in each end of the case making it easy to carry.—H. LEEPER.

Slides Dated. Tiny gummed labels placed in a corner of mounted color films serve a dual purpose. The date the exposure was made may be marked on the label, and it also will act as a guide in inserting the slide in the projector so it faces properly.



Switch Reduces Eyestrain. Coupled to the camera shutter, a dim-bright-dim switch developed by Leonard Parke, of Coconut Grove, Fla., makes it unnecessary for portrait subjects to pose under hot studio floods. While the subject is being posed, the floods are dim. When the exposure is to be made, the photographer squeezes the bulb and the lights rise to full intensity as the shutter clicks, returning to dim after the exposure. Marketed as the Parke Eye-Saver, the switch sells for about $35.



Cards Tilt Camera. When a camera is placed on a table or other improvised support, playing cards provide a handy means of getting the right amount of tilt. By adding or removing a card or two from the pile, you can frame the picture exactly.

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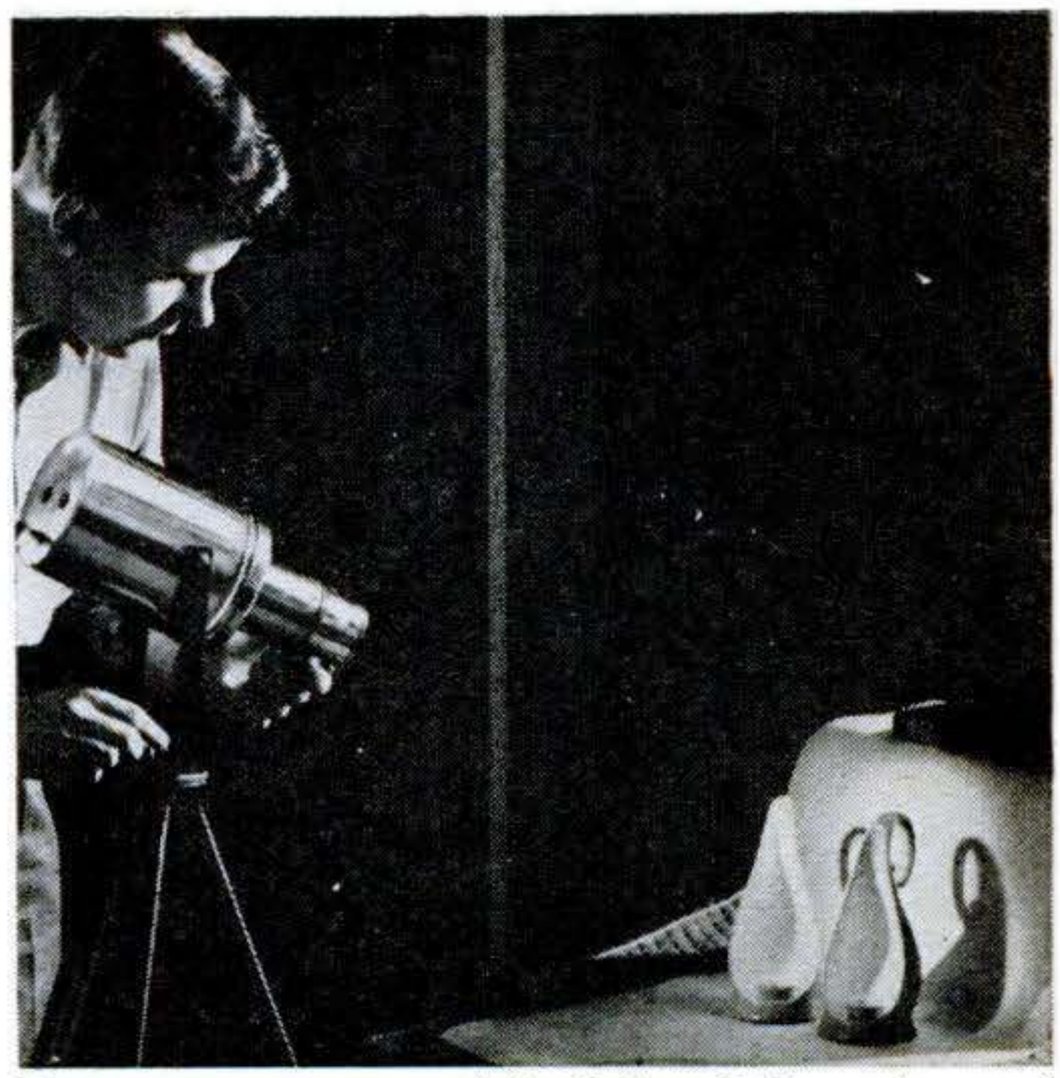
Three tin cans, a No. 1 photoflood bulb, and a 2½" hand magnifier are the major elements.



Focusing is accomplished by sliding the end can in and out. This can has a felt bushing.

Tin-Can Spot Highlights Your Pictures

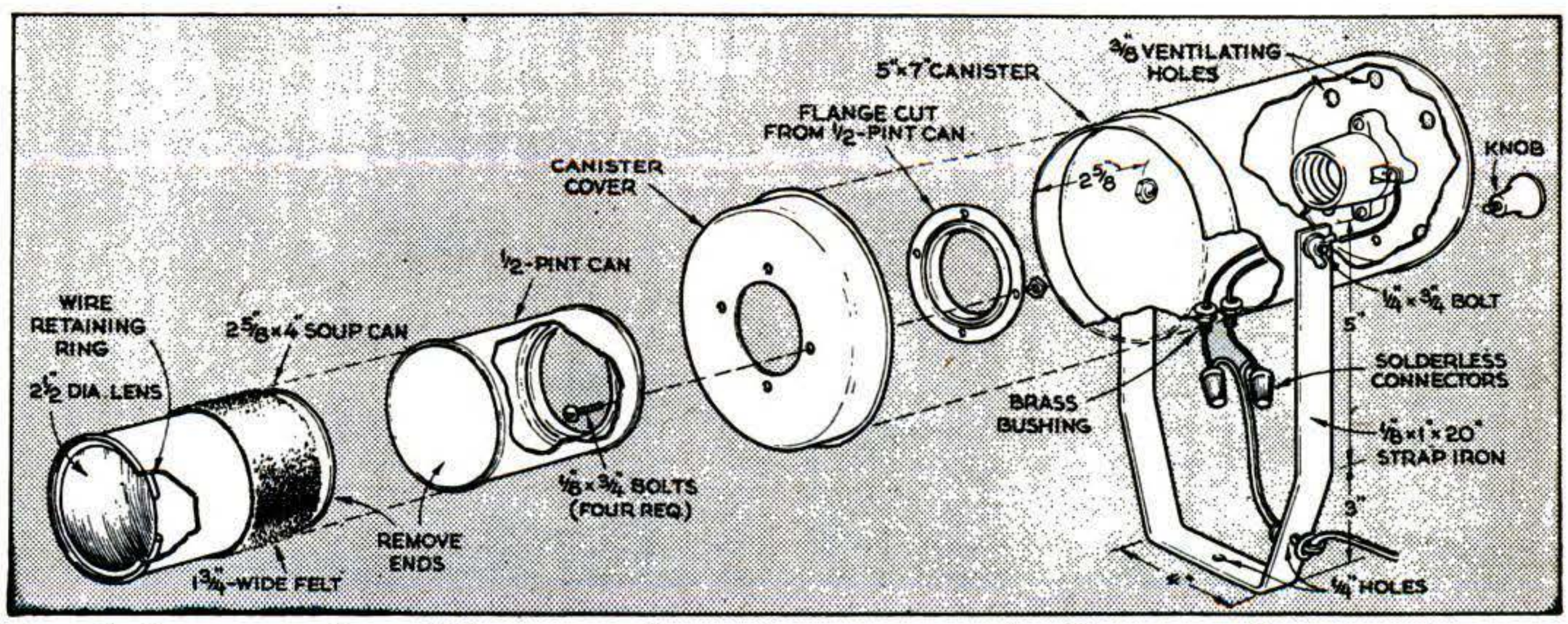
FOR special effects in photography, a spotlight is practically indispensable. Here's one built around an ordinary kitchen canister and so easy to construct that one evening should suffice to complete it. A No. 1 photoflood bulb supplies the light, and the lens is the glass from a hand magnifier.

Scribe a line across the center of the canister bottom, center a lamp receptacle on the line, and pierce for the mounting holes. Also drill or punch other holes as indicated for ventilation and for the knob, the cord bushings, and strap-iron bracket.

Remove the bottom from a ½-pint paint can and cut the top flange from a similar can. In the center of the canister cover, cut a hole the size of the flange opening. Then, holding the flange, cover, and can in sequence, drill holes for the four ⅛" by ¾" bolts that hold them together.

Cut one end from a soup can with a rotary opener and in the opposite end cut a hole ⅛" smaller than the lens diameter. Form a lens-retaining ring from stiff wire. Cement felt around this can to make it a snug sliding fit in the other. Small dents made in opposite sides of the canister and cover with the latter in place will hold it on securely. Polish the cans with steel wool.

For convenience, install a switch in the electric line.—PAUL F. SASS, JR.



Four bolts secure the middle can to the canister cover and a flange cut from another can.

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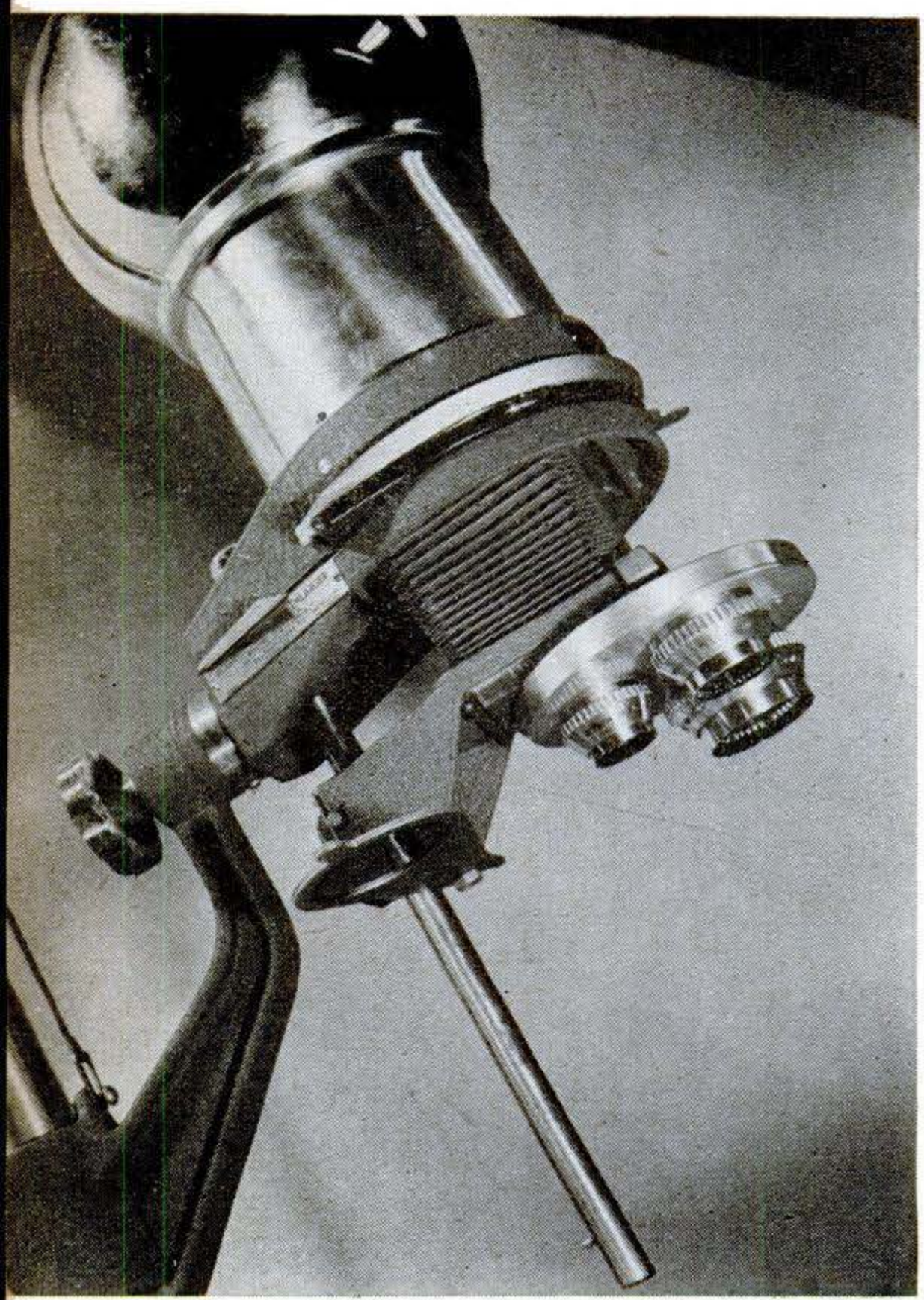


When mounted, the turret will enable you to pick quickly the lens best suited to any negative.

Turret Changes Enlarger Lens

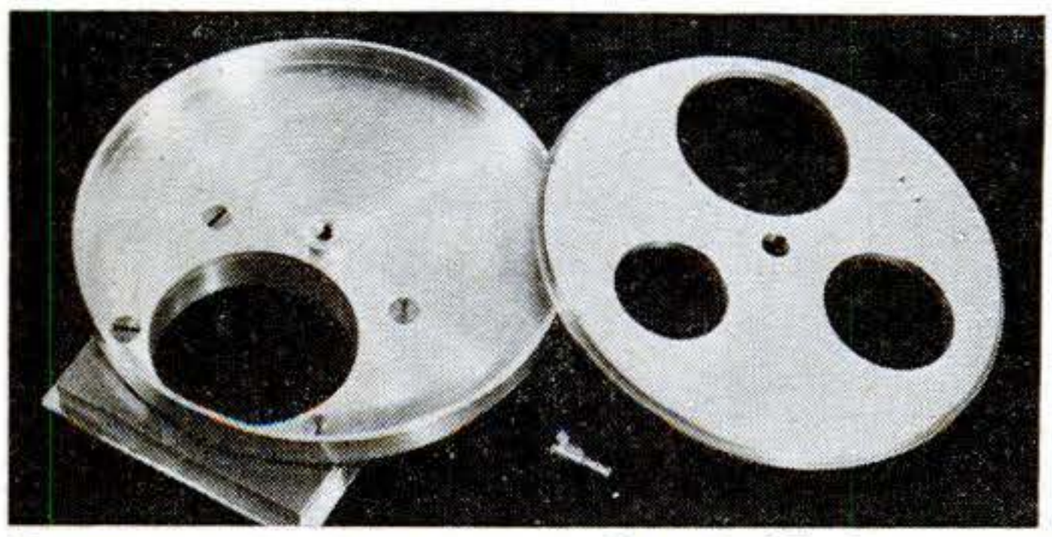
By A. H. Honest

IF YOU use several lenses for enlarging negatives of different sizes, this turret will enable you to turn any one of three quickly into position for use. The idea was adapted from motion-picture cameras that have a turret for changing lenses.

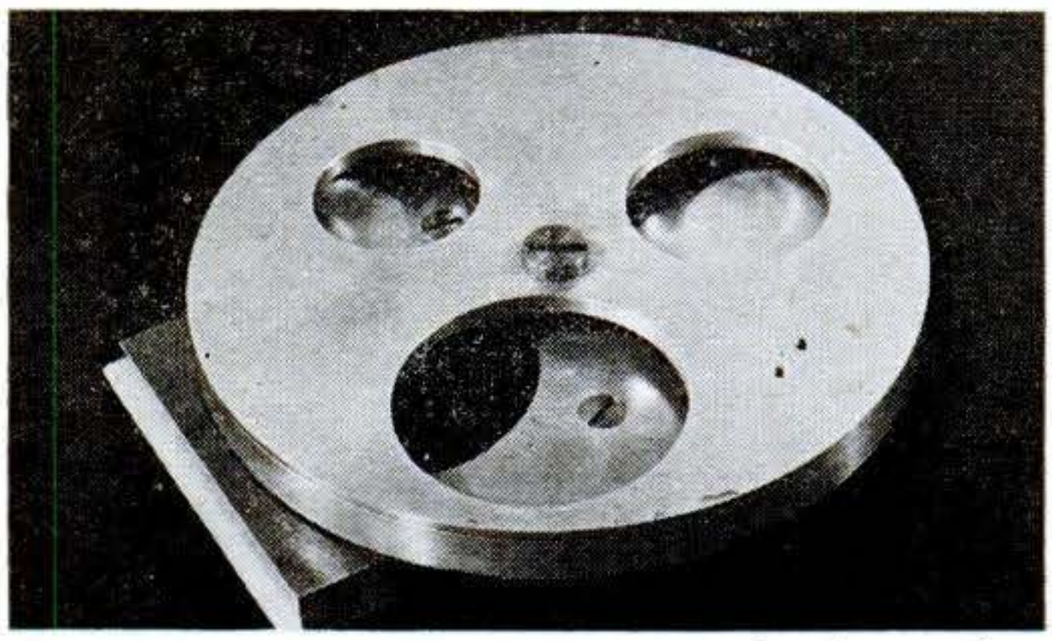
Although the turret presented here was designed for an Eastman Precision Enlarger, it can be suited to one of another make by altering the mounting plate as necessary. The turret holds 2″, 3″, and 4″ lenses—enough to take care of any negative within the capacity of the enlarger; that is, from 35 mm. to 2¼″ by 3¼″.

For lightness, it is advisable to machine the cover, mounting, and lens plates from aluminum alloy, although another metal could be used. Turn the shouldered screw from cold-rolled steel. This screw holds the lens plate in position and allows it to rotate. Follow all the dimensions exactly. This is important to assure that each lens will be in proper alignment when turned to the projection position.

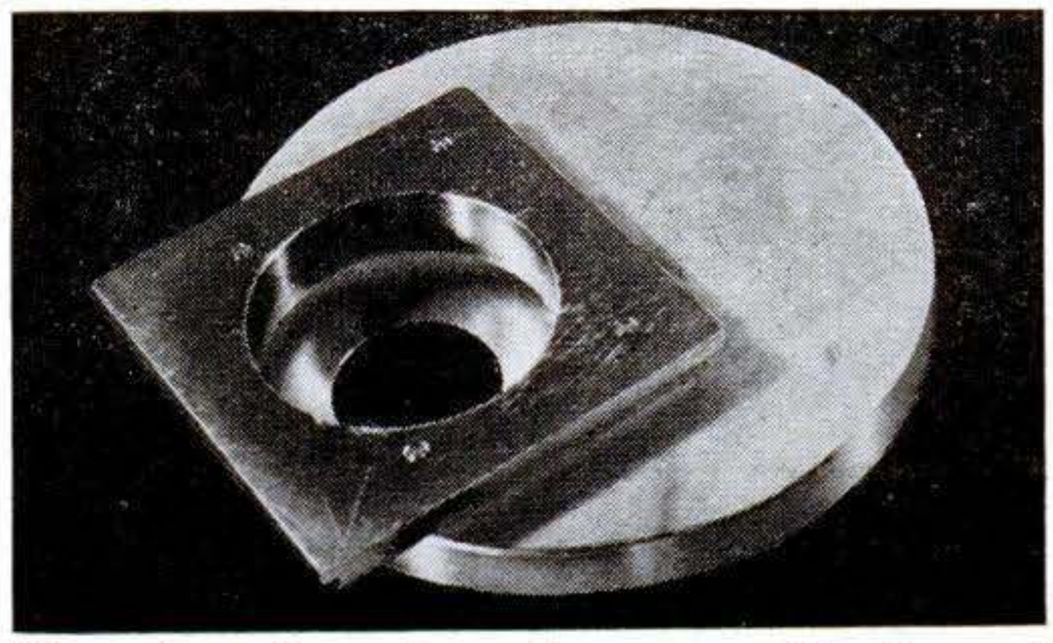
Two small holes originally were provided in the lens plate for a click-stop spring, but this is optional. Matching marks scratched on the edges of the lens and cover plates were found to be just as satisfactory for locating the lenses properly.



Countersink the screws that hold the cover to the mount. Note shoulder on the lens plate.



Closely fitted into the cover, the lens plate should revolve smoothly on the center screw.



Mounting plate dimensions are easily changed to suit your particular enlarger if necessary.

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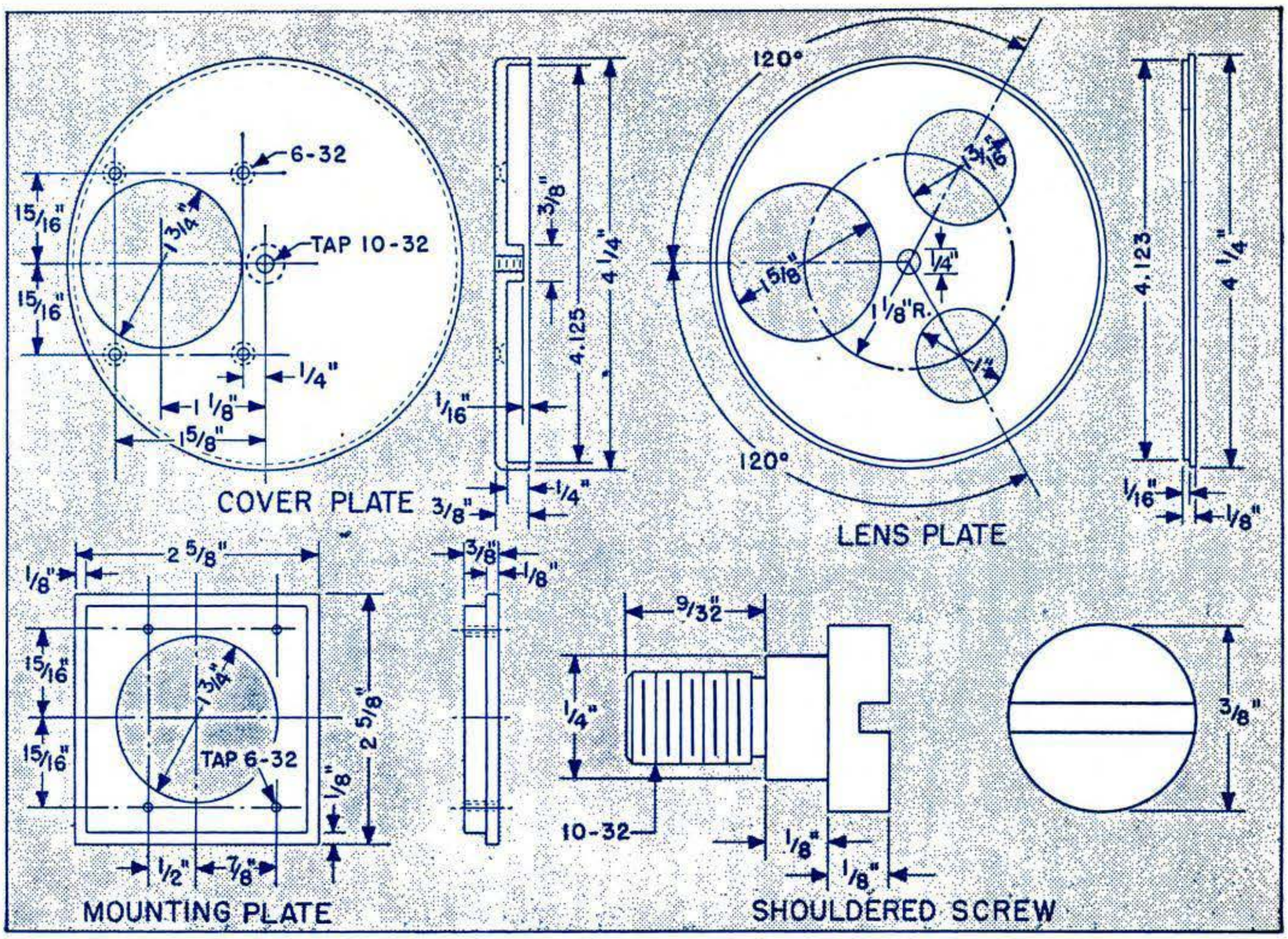
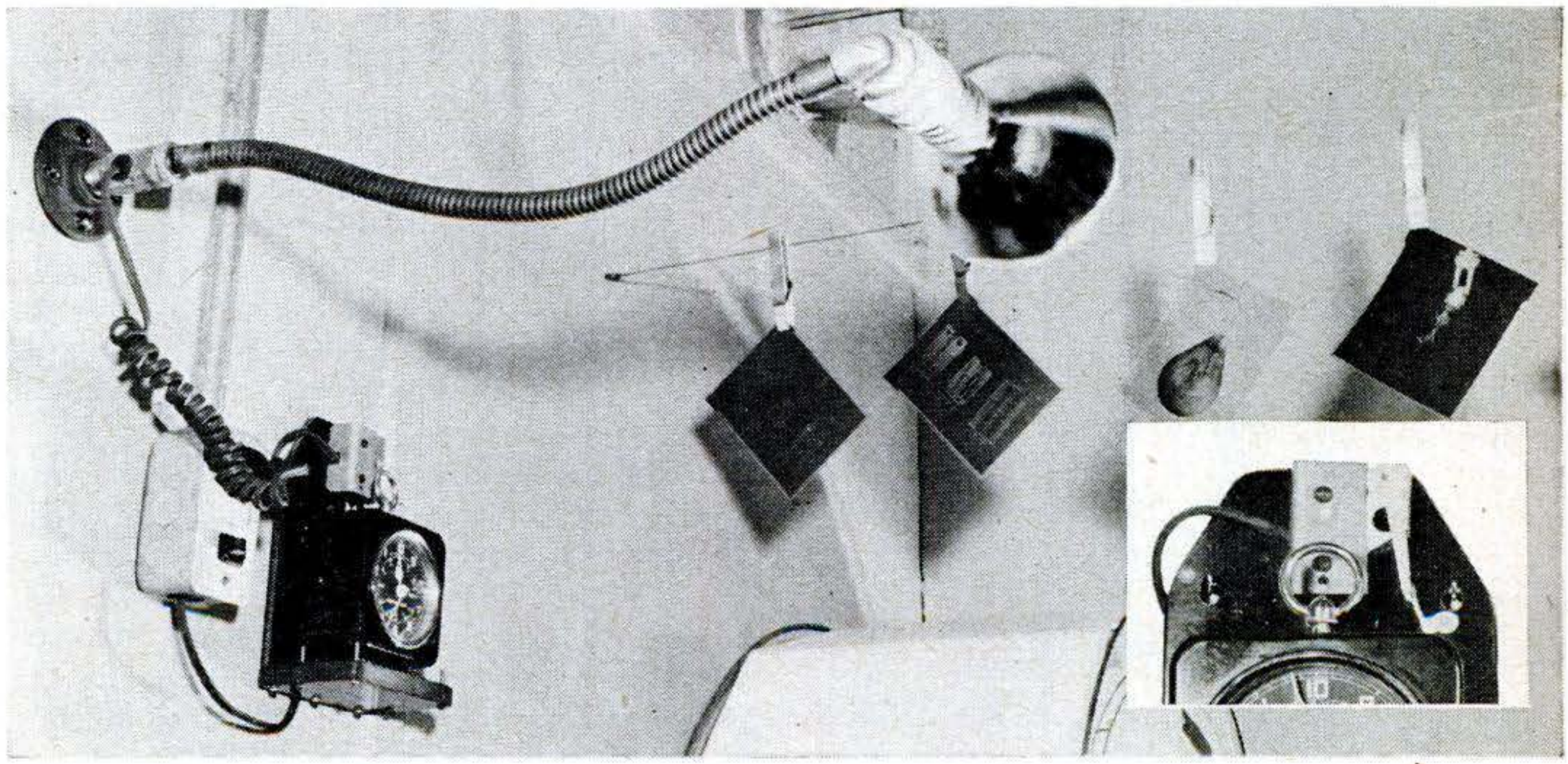


Turn the shouldered screw from cold-rolled steel. Use aluminum alloy for the three plates.

Infrared Lamp Dries Negatives in 20 Minutes



HERE is a method I am using successfully to dry negatives with an infrared lamp. With the face of the 375-watt lamp 18" away, 4" by 5" cut film dries in 20 minutes instead of the 90 I used to allow. A standard interval timer shuts off the light at the end of 20 minutes.

An 18" length of gooseneck, fitted with a porcelain socket, is attached to the wall near an outlet box and switch. The timer is located on an adjacent shelf. A microswitch with a roller trip arm is positioned on the back of the shelf so that the timer lever will actuate the switch. The timer may be lifted off for use elsewhere. Four screws prevent it from creeping.—G. DEXTER HERNDON.

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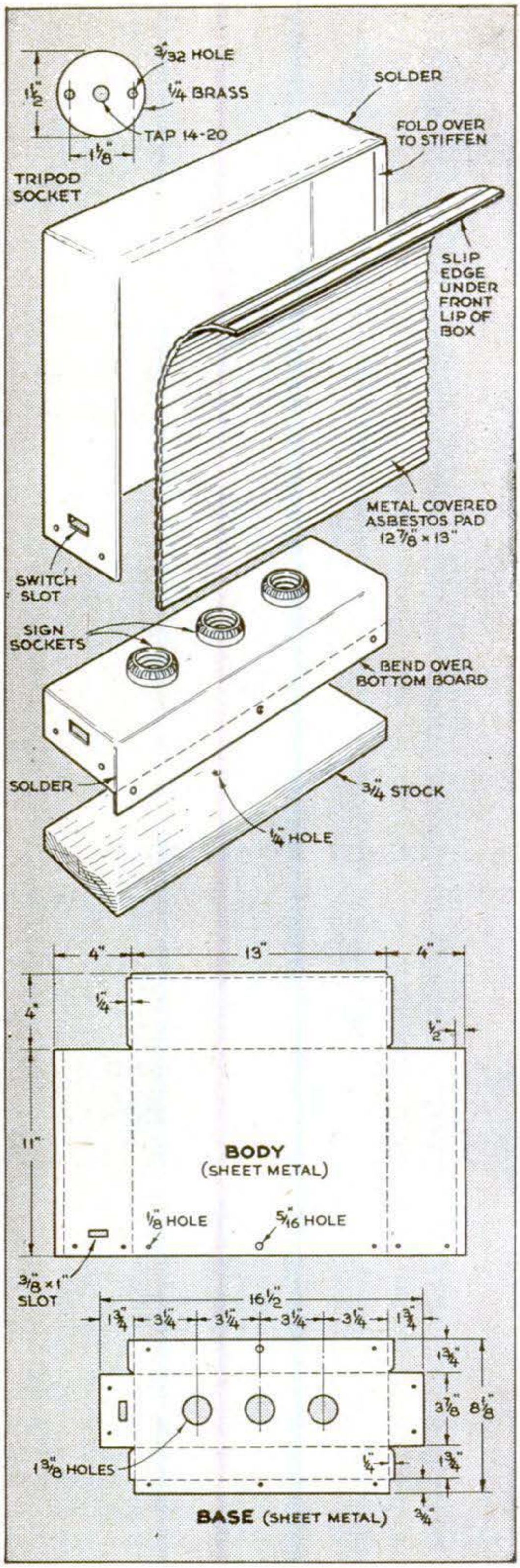
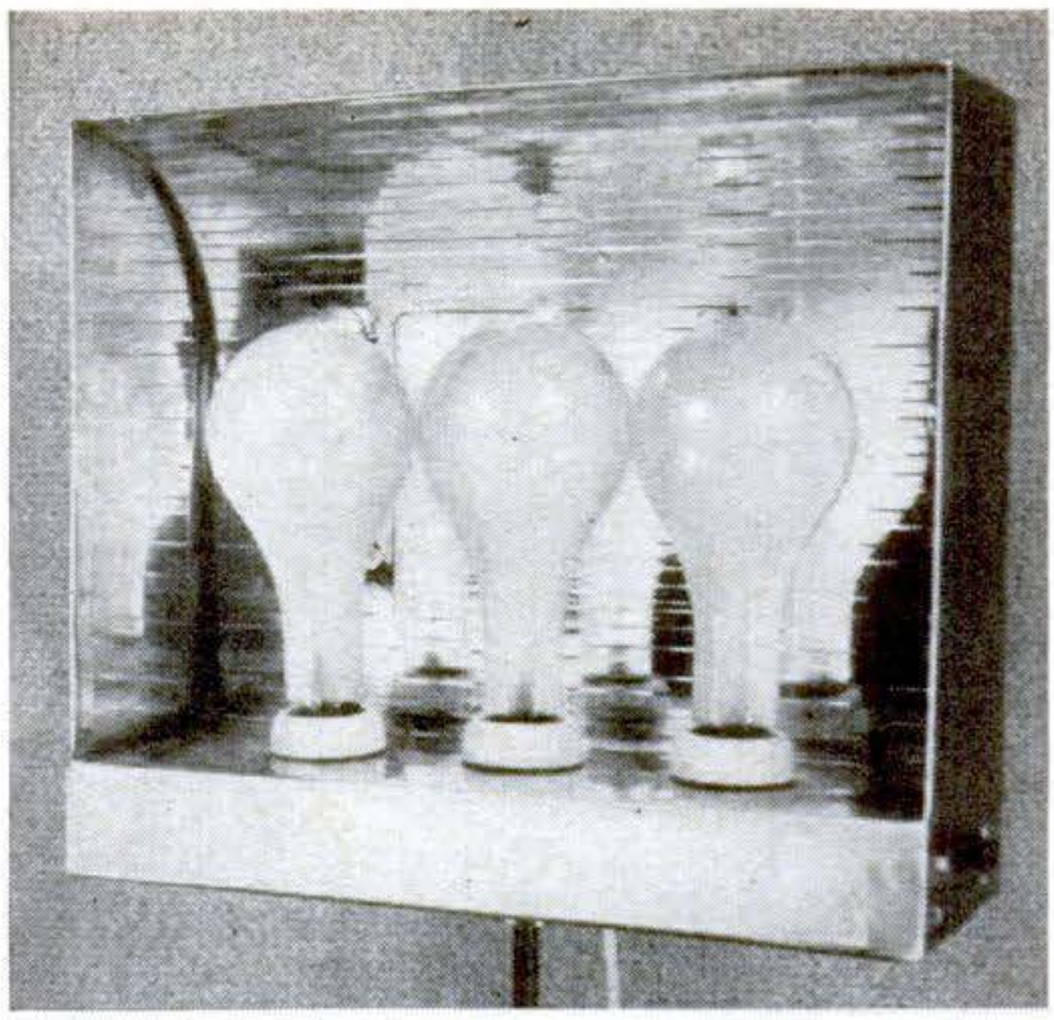


Thin sheet metal, easily snipped to shape, is used for the box and base. Solder all joints.



Brightly tinned, an asbestos plate pad makes an excellent reflecting element inside the box.

Box Reflectors for Flood Lamps Increase Light

TWO of these box reflectors, each holding three No. 2 photofloods, will provide all the light you'll need for virtually any ordinary photograph taken indoors. If you're reasonably adept with tin snips, you can make the units with little effort and expense.

The reflector is a pad of the type that housewives use under hot dishes. These pads have two advantageous features—a brightly tinned surface giving you a tarnish-proof reflector, and a back of thick asbestos that you'll appreciate with all three lights going. Buy a medium-size pad and cut it down to fit.

For the two boxes, your local hardware store or tinsmith probably can supply thin tin plate or galvanized iron. After cutting the body and base, bend them as indicated. Holes for the sign sockets, which are mounted with threaded collars, can be cut in the base with a cold chisel. In assembling, notice that the top edge of the reflector should be slipped under the upper edge of the box before the latter is flattened. Solder all the joints.

Install a switch in the indicated slot, wire the three sockets in parallel, and fit the bottom board into the assembly and secure with wood screws. To this screw a tripod socket tapped ¼"-20.—JACK MELLINGER.

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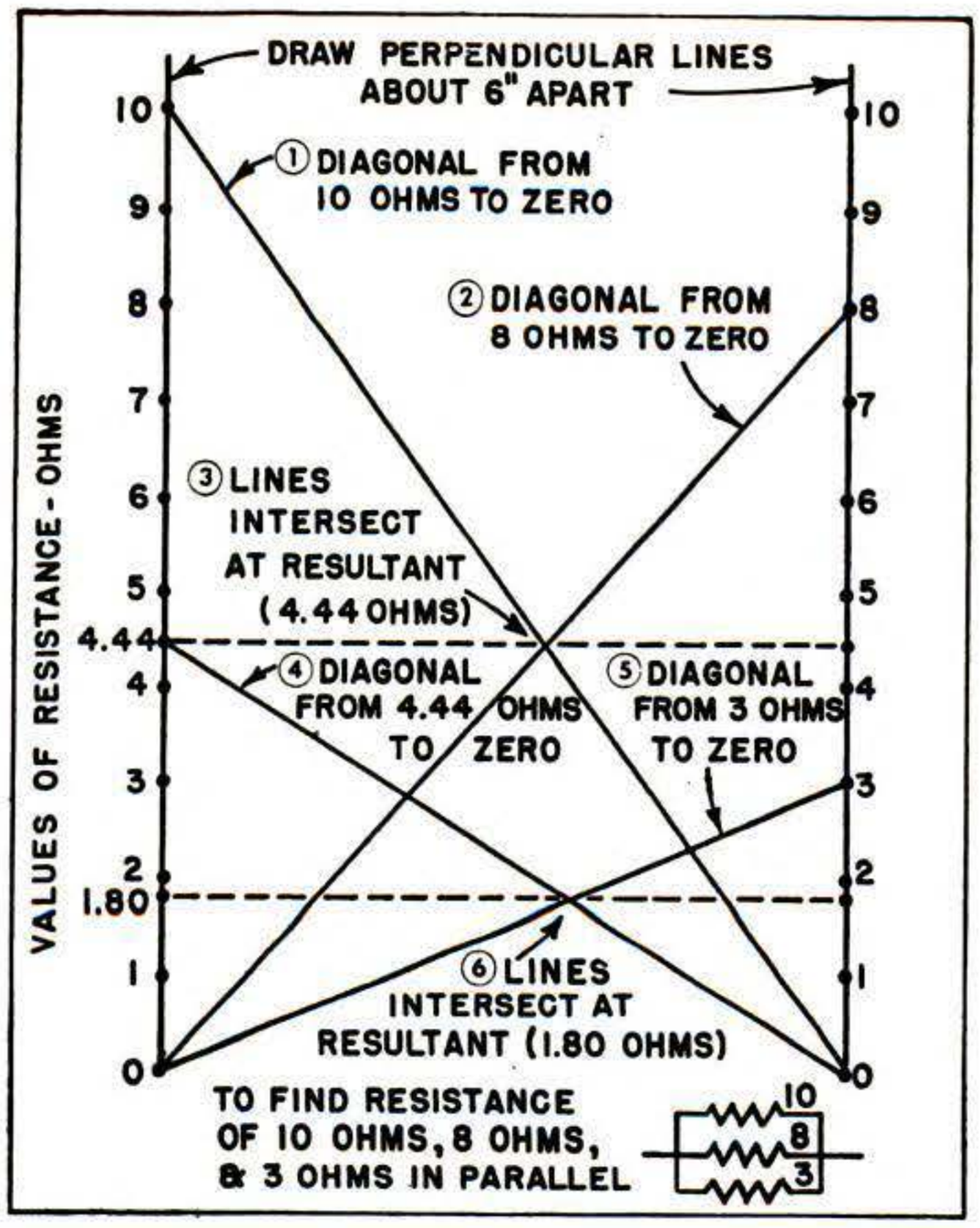


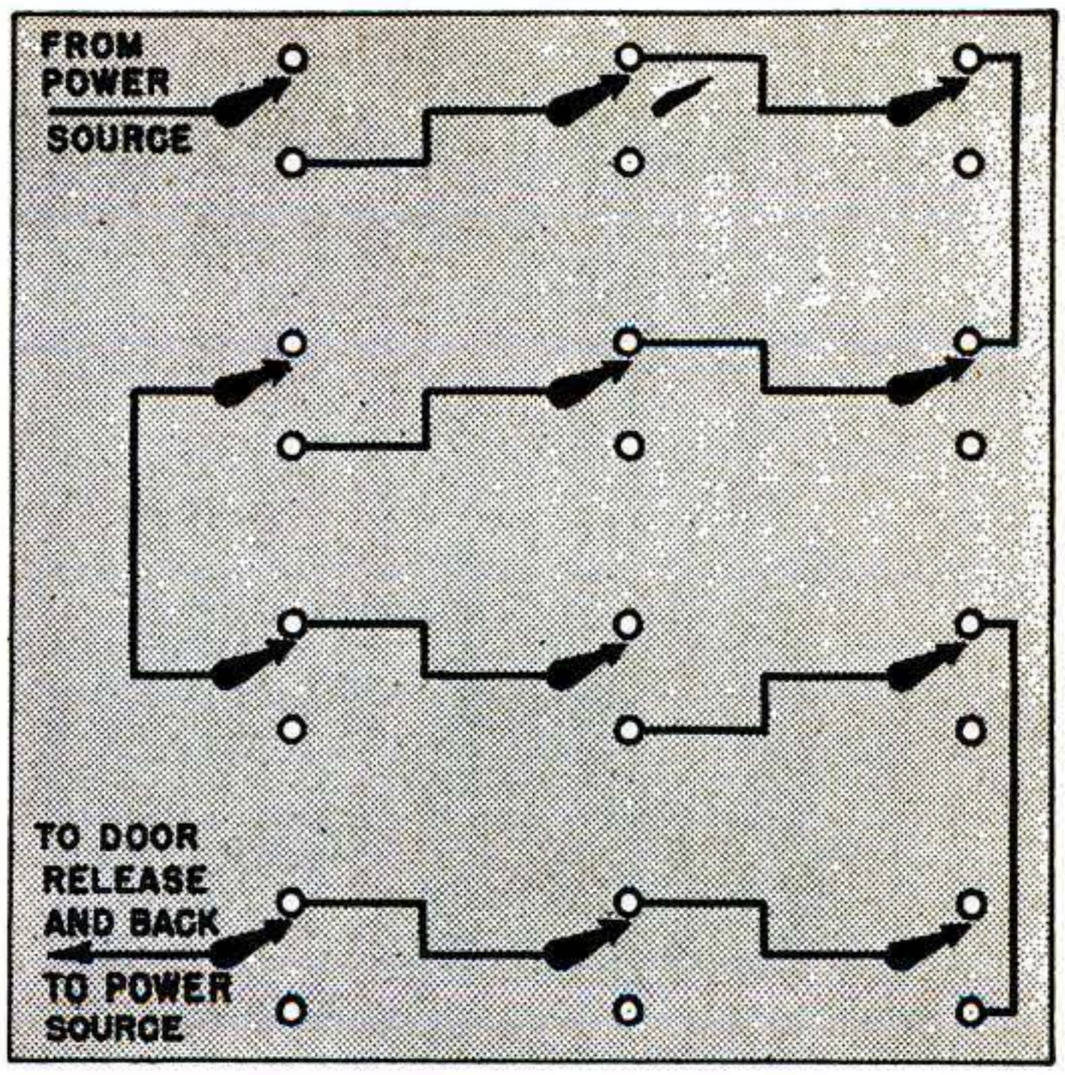
Graph Adds Parallel Resistors

ONE of the more tedious jobs in electrical work is calculating the combined resistance of resistors in parallel. The classical method is to add reciprocals, but if the range of values is not too great, there is a simpler way that is accurate enough for most practical purposes.

On some ruled paper, draw perpendicular lines about 6″ apart. From the horizontal line representing the highest resistor —10 in the sample above—draw a diagonal to zero. Do the same on the opposite side with the next highest. Extend the point of intersection to the margin (4.44 ohms) and repeat for this and the third resistance. The resultant is found where the lines intersect. You can continue for any number of resistances; when the page becomes crowded, transfer the last figure and continue on a new sheet.—JOHN W. LA LONDE.

Inlay Decorates Radio Panel

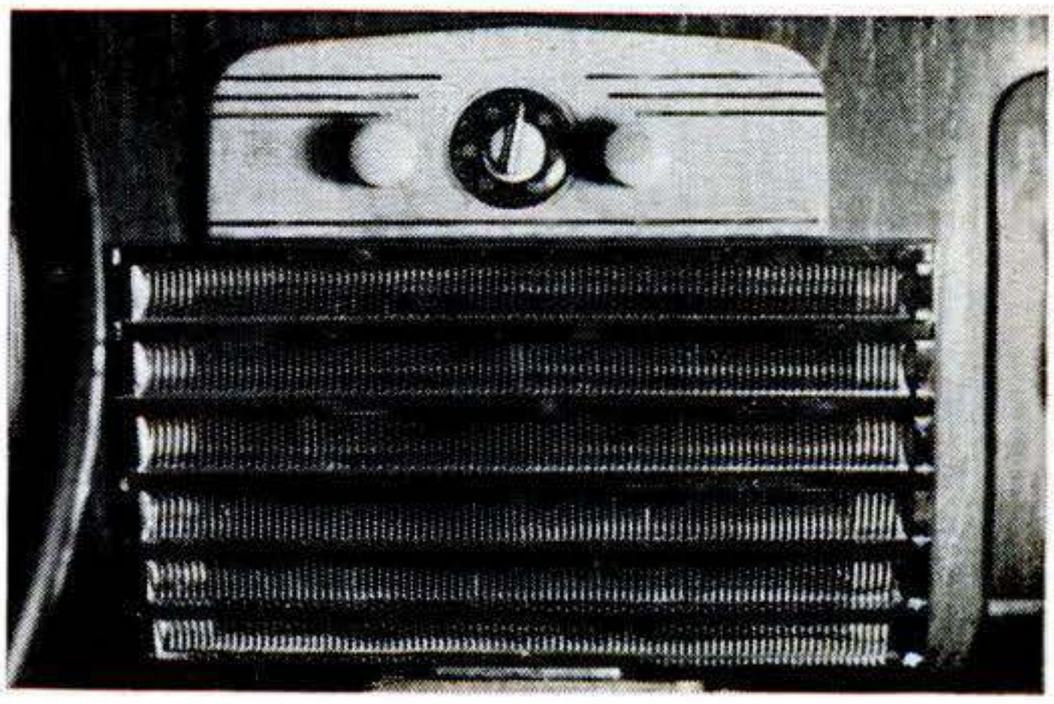
FOR craftsmen who like to work in wood, a custom-made auto-radio panel is a satisfying project. The one at the right is made of curly maple with mahogany inlay. Richer in appearance than the chrome escutcheon it replaced, it also harmonizes with the car's interior. The back of the panel is routed for the metal retaining plate, and curved to fit flush against the rounded contour of the dash.—GLENN A. WAGNER.



Switches Act as Door Lock

AN ELECTRIC combination lock is extremely handy on a frequently used door such as that of a workshop. No key is needed, and the combination can be changed at will. A sliding bolt withdrawn by a magnet or solenoid may form the lock, or if you want a key lock in addition, a magnetic strike such as is installed on apartment-house doors can be used.

The combination consists of from six to 12 SPDT switches, either flush mounting or the toggle type, wired so that they must be thrown in a definite pattern for a continuous circuit to open the lock. With 12, thousands of combinations are possible. All wiring must be concealed and inaccessible from outside.—CHAMBERLAIN FERRY.



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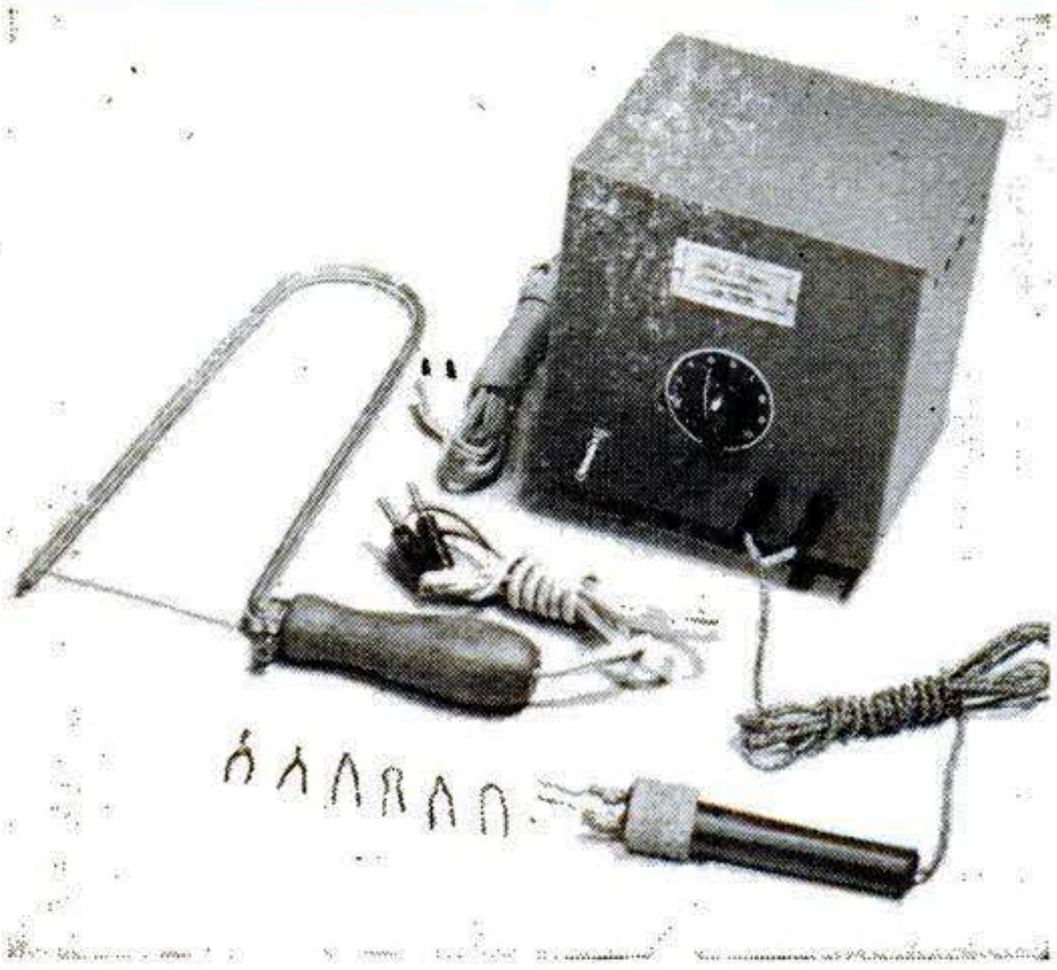
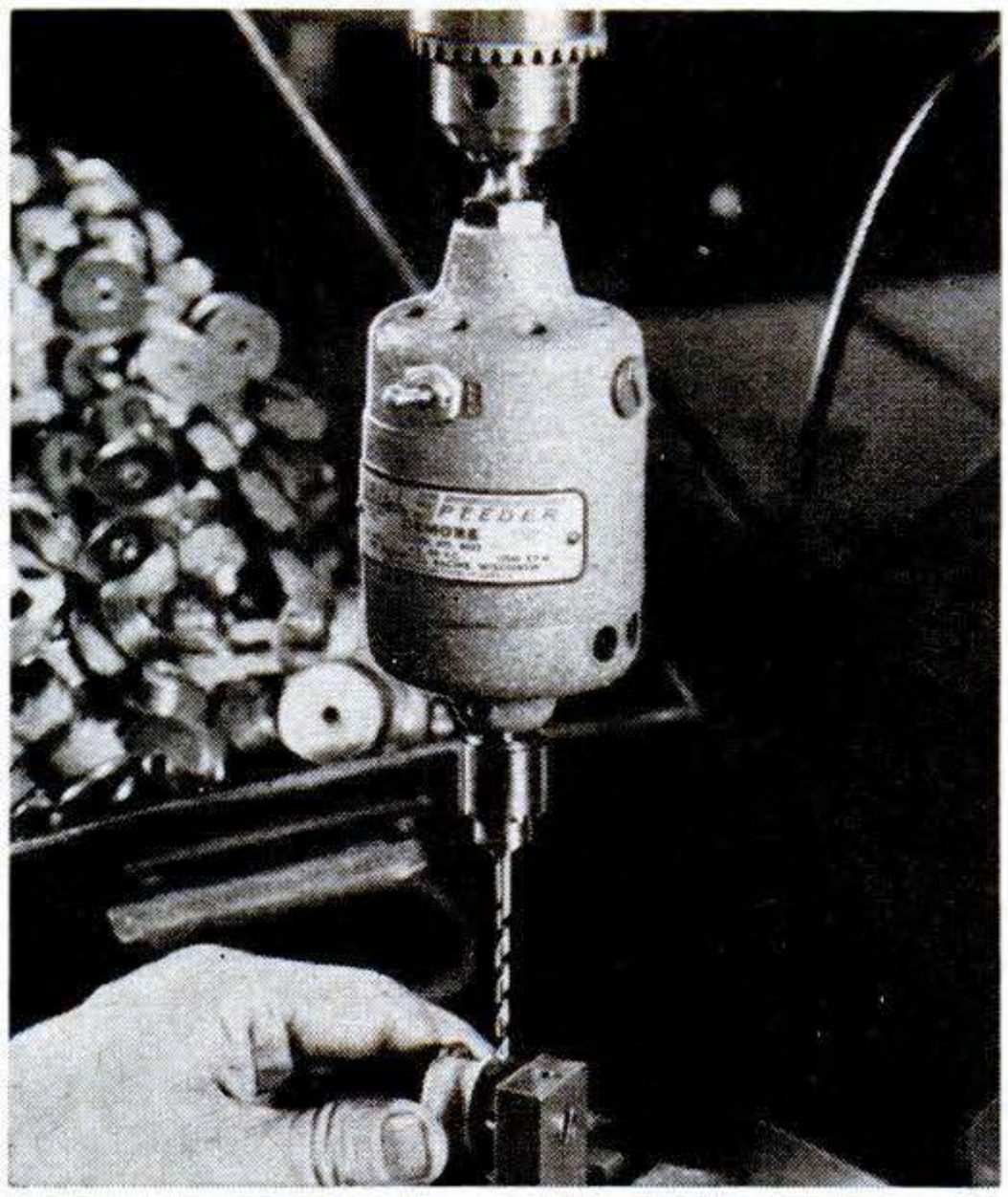
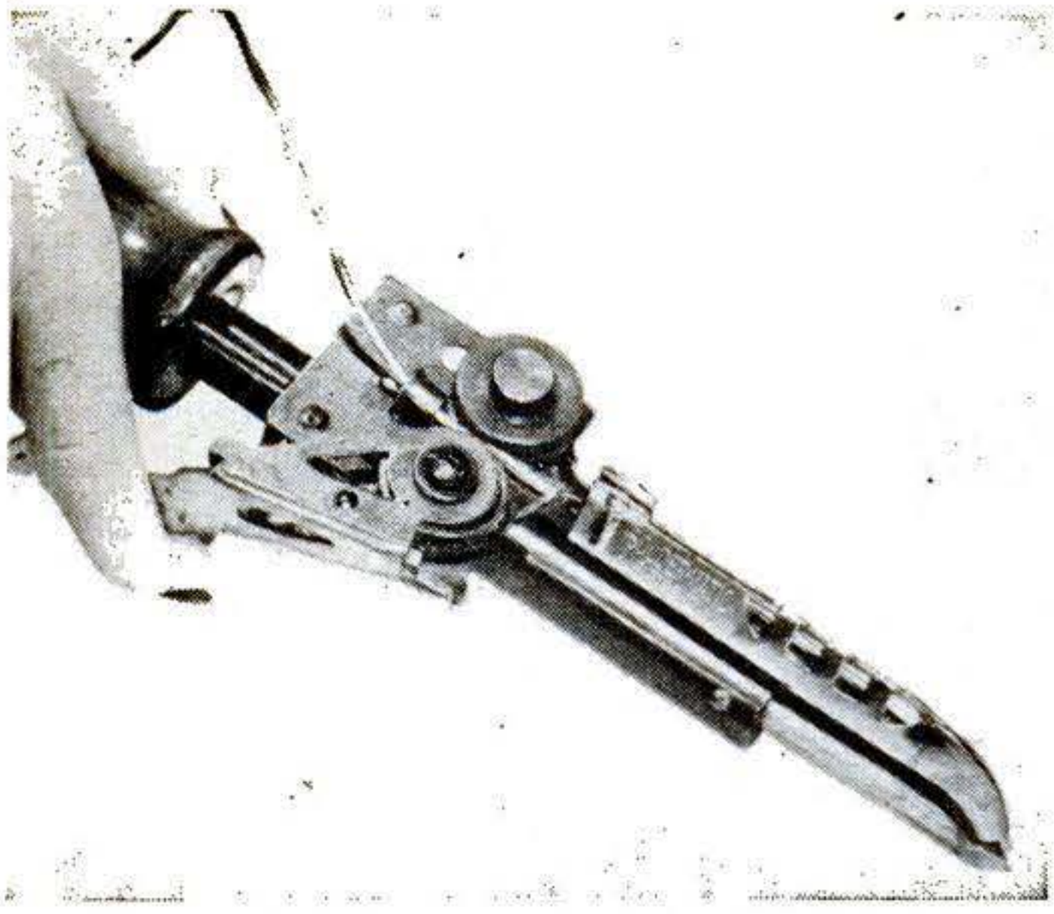
NEW TOOLS



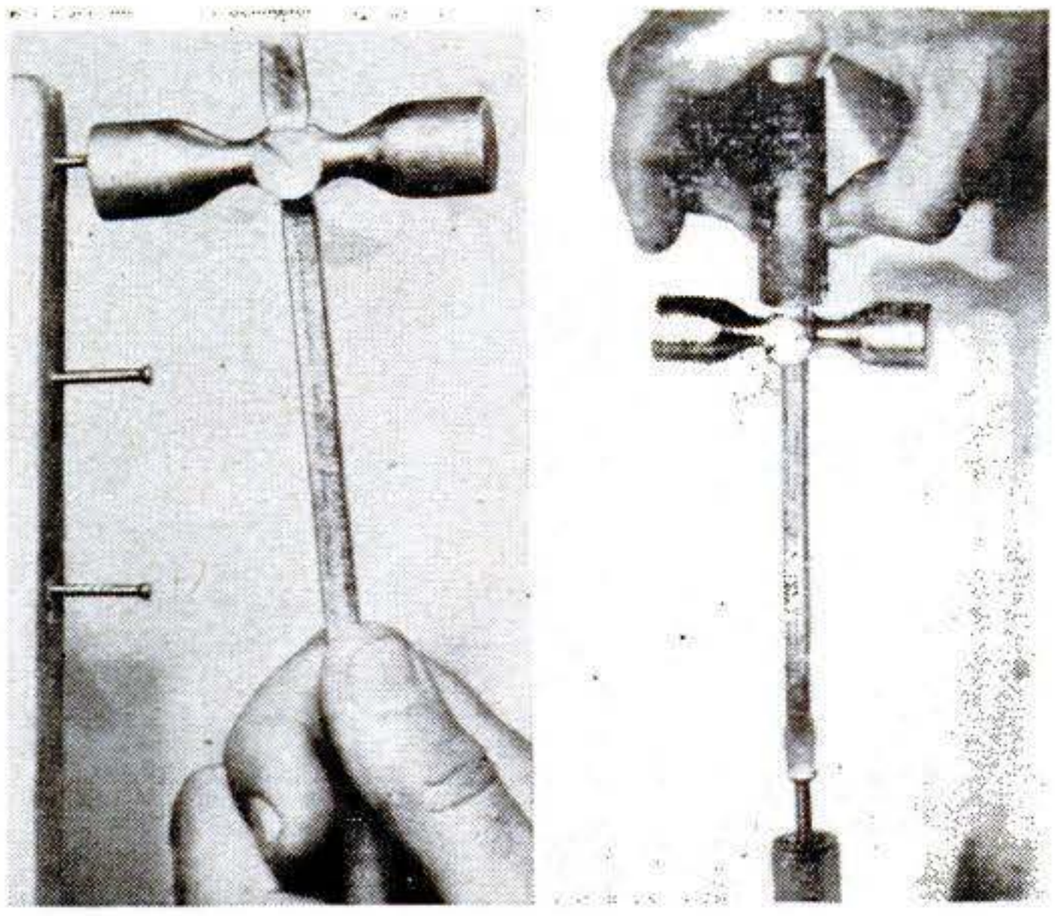
Tool Aids Plastics Work. This outfit was designed especially for both internal and external cutting and carving of plastics by means of heat, but can also be used for wood and leather. It is made in two sizes, the larger including a hot-wire saw, cutting and carving tools, a control box, and extra accessories. Both sizes operate on 115-volt AC. The distributor is Barnett Specialty Co., Los Angeles.



Drilling Speeded Up. A self-contained, high-speed electric drill announced by the Dumore Company, Racine, Wis., is intended for use in any standard drill press, lathe, or milling machine. Operated at 17,000 r.p.m. by its own 1/16-hp. motor, it accommodates drills from No. 80 up to ⅛″. Although the tool is normally supplied with a ⅜″ taper shank, a No. 2 Morse taper shank can be obtained if desired.



Solder Fed to Tip of Iron. An attachment that may be clamped on any standard electric soldering iron supplies wire solder to the tip of the iron at the touch of a lever. An adjustable stainless-steel nozzle guides the solder exactly where it is needed. The attachment is produced by Nelpin Manufacturing Co., Long Island City, N. Y.



It's Called a Spindriver. A tool made by the Skamser Spindriver Co., Los Angeles, is both a screwdriver and hammer. When it is used as a screwdriver, the balanced head serves as a flywheel to help spin home the screw. When a hammer is needed, the head slips along the shank and is held by a thumbscrew. It sells for about $2.

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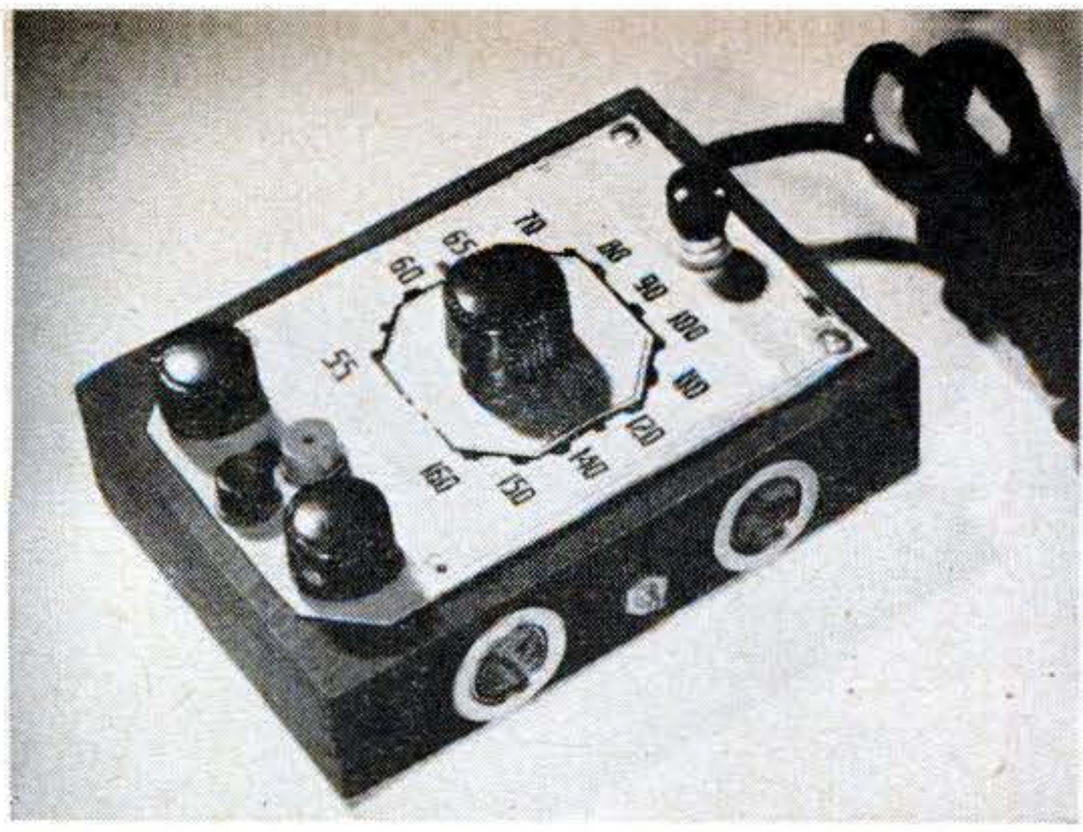
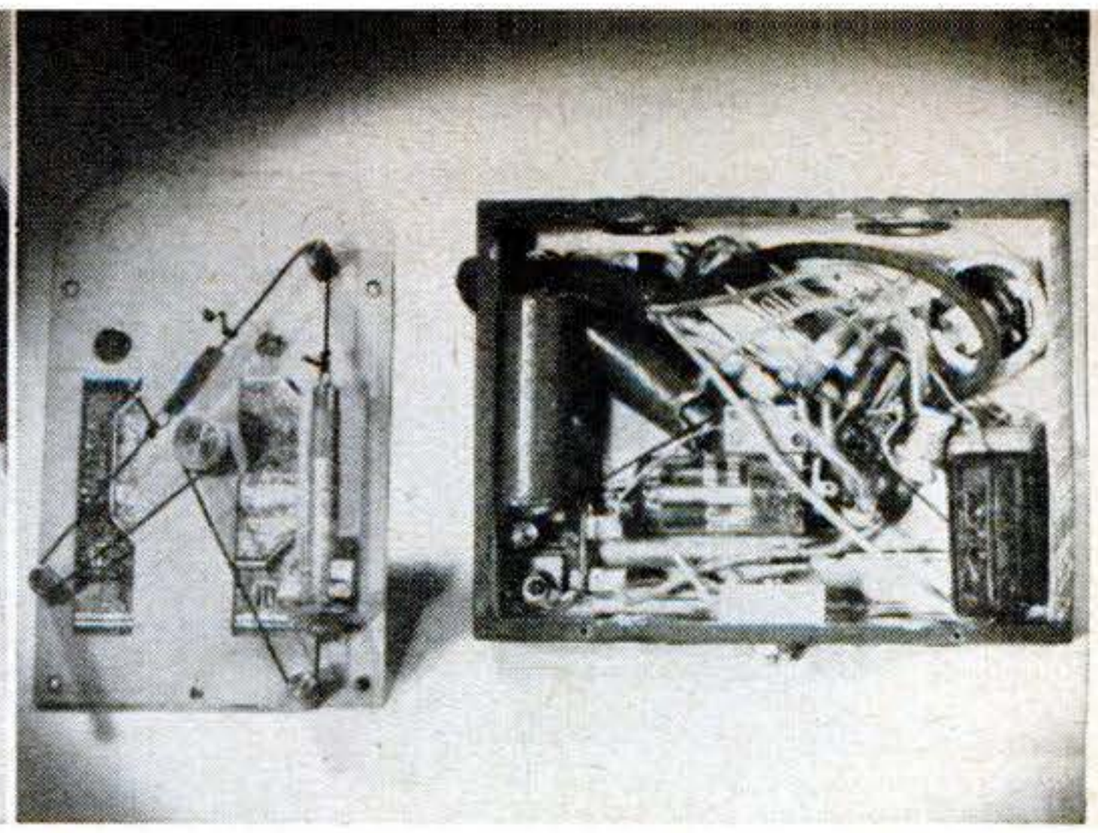


The dial plate on which the slug-tuning unit is mounted makes up the face of the receiver.



The back of the tuner is shown at left. Next to it is a rear view of the complete receiver.

Pocket Set Has Permeability Tuning

COMPACTNESS in radio receiver design has been achieved in many ways, but when really tiny sets are made they will probably employ permeability tuning. In this regenerative circuit the usual variable condenser and the coil with primary, secondary, and tickler windings are replaced by a thin plastic form 5/16″ in diameter around which is wound a special low-resistance coil. An iron slug moves inside the form to vary its inductance and tune to any frequency in the broadcast band. The tuning unit used comes mounted on a 3¼″ by 5″ metal plate; dial and pointer are on the reverse side.

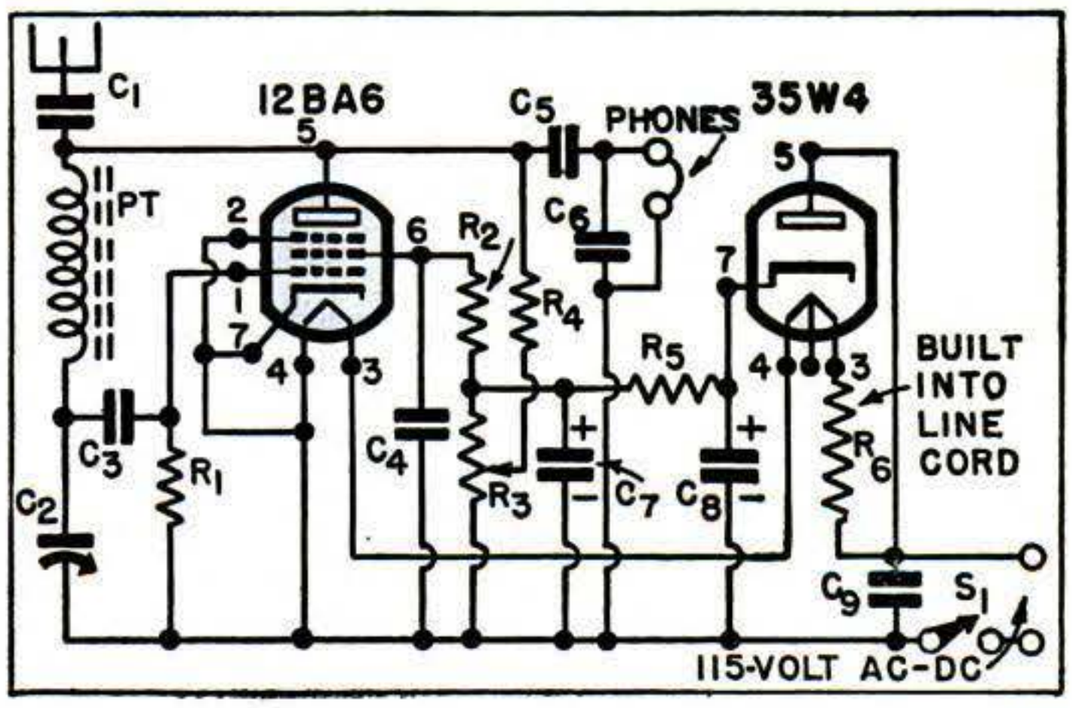
The single coil of the tuner serves for both antenna and tickler windings; the latter acts as a feed-back path between plate and grid. Regeneration is obtained by varying the interelectrode capacity of the 12BA6 detector through the 100,000-ohm potentiometer, R3. When this capacity is high, the circuit breaks into oscillation. As the plate voltage is decreased, the plate-to-grid capacity decreases and the tube becomes less sensitive to incoming signals. Best reception is obtained when the potentiometer is set just below the point where oscillation begins.

Four ¾″ wire-mesh ventilators are let into the sides of the 1 3/16″ by 3⅞″ by 5⅜″ wooden box. Shafts for the switch and regeneration control are brought out through the panel and holes are drilled for mounting the earphone jacks and the antenna binding post. Post and jacks must be of the insulated type and should not make contact with the metal panel.

No chassis is needed since heavy bus bar is sufficiently rigid to support the tube sockets and other light components. When wiring the set, leave the tubes in their sockets to insure proper spacing of the parts. Adjust C2, the .001-mfd. trimmer that is brought out through the side of the box, until stations come in at their proper dial settings. Do not use an external ground, since this connection is already made through the 115-volt AC or DC line. A hank of wire will serve as an antenna, or you may connect the set to an outdoor aerial.—EDWARD BLANTON.

LIST OF PARTS

R1: 5 meg., ½ watt carbon.
R2: 150,000 ohms, ½ watt carbon.
R3: 100,000-ohm potentiometer.
R4: 50,000 ohms, ½ watt carbon.
R5: 10,000 ohms, 5 watts ribbon-wound or carbon.
R6: 430-ohm line-cord resistor.
C1, C5, C9: .005 mfd., 400 volts midget tubular.
C2: .001 mfd. (max.) trimmer.
C3: .0002 mfd., mica.
C4: .1 mfd., 400 volts, paper.
C6: .002 mfd., mica.
C7: 16-mfd., 150-volt electrolytic.
C8: 20-mfd., 150-volt electrolytic.
PT: permeability-tuning unit for regenerative circuit.
S1: SPST rotary.
Tubes, sockets, insulated phone tips, binding post, steel-mesh ventilators, misc. hardware.



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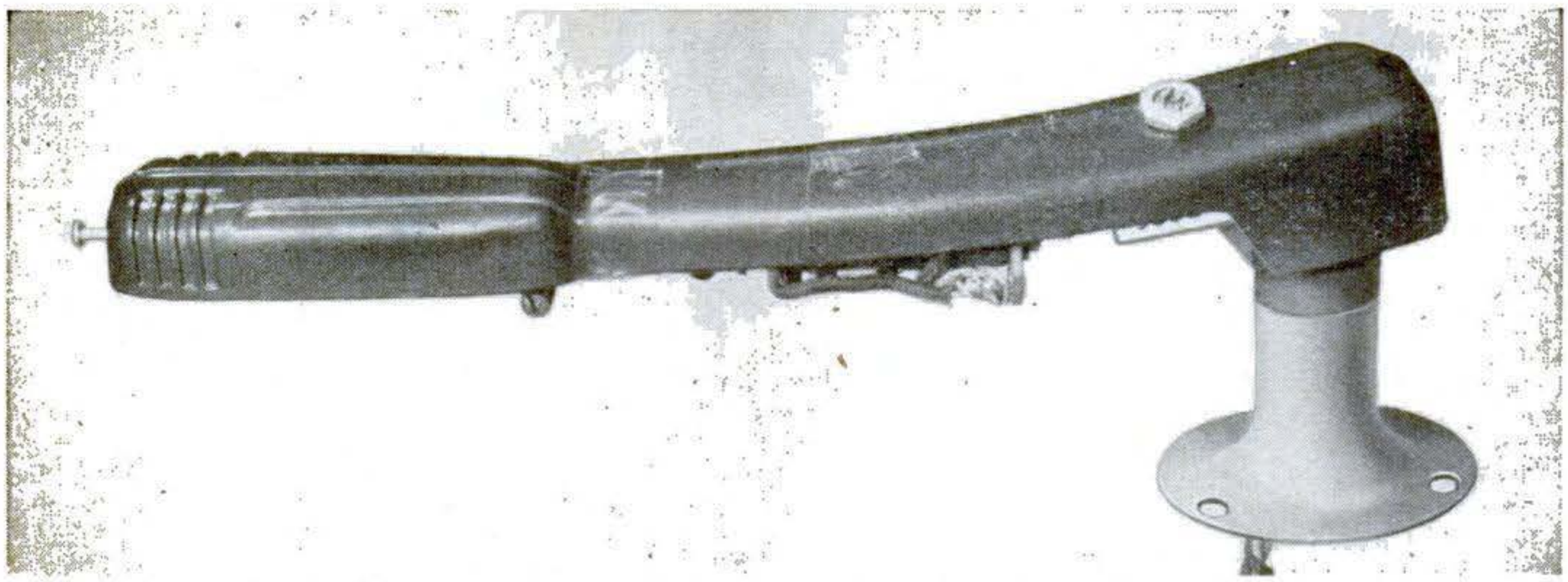


Complete phono oscillator, built into the arm of a pickup, plays records through any nearby radio. Screw or clamp the flange so that the needle will track on a turntable, and tune in.

Playing Records with One Tube

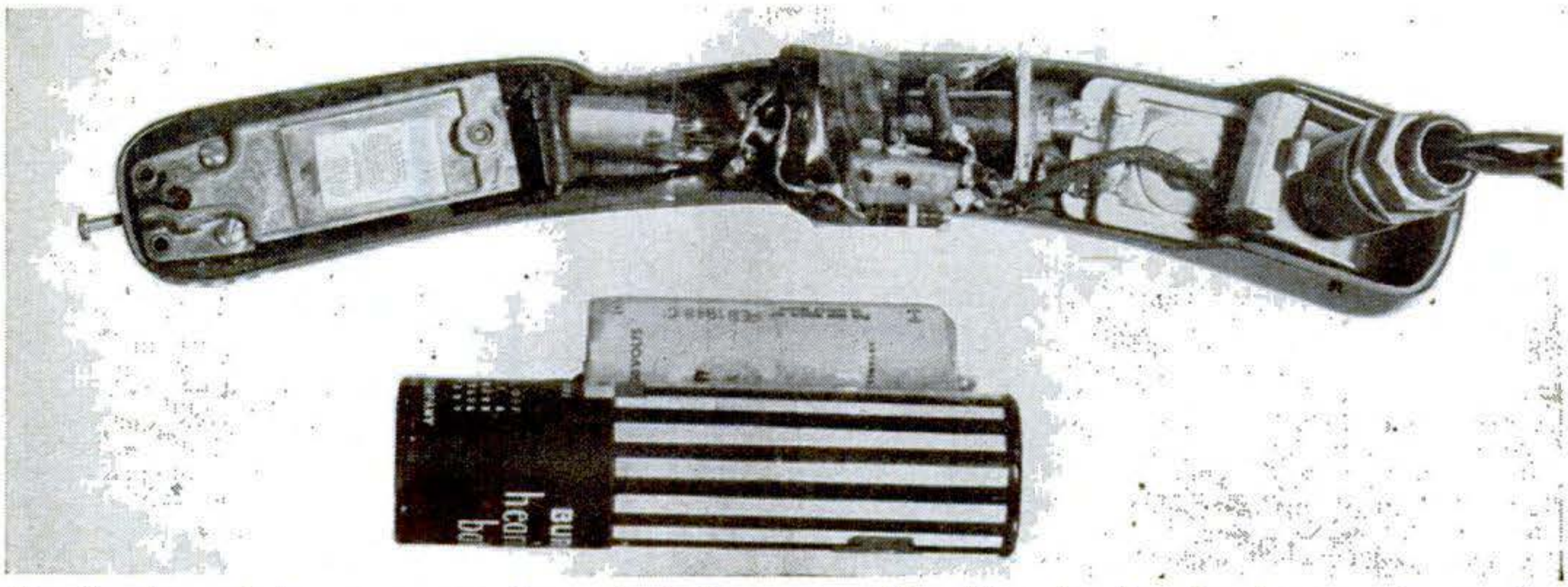
Want an extra phonograph for den or shop? Take your pick of these three one-tube music makers.

MOST people who live in large households know the advantages of having one or more small radios scattered around the house. If you want to listen in while you work, play, or rest, or if you just want to hear a different program from the one that's coming in over the living-room console, you can go off and tune in on your own private set. It's different with phonographs, but it doesn't have to be. Here are three different models that can be built easily and inexpensively, each around a single tube.

Pictured on this and the facing page is a novelty design by Frank Tobin; it may be used with any phono motor to play records through a radio. If you have an odd turntable around, or a portable phonograph that doesn't sound too well, just clamp on this pickup and tune in through a nearby radio. Inside the tone arm you have a complete miniature broadcasting station.

Oscillator Built in Pickup

A subminiature tube, the 2G22, acts in this circuit as a pentode modulator and triode oscillator. Designed for pocket receivers, it requires a plate potential of only 22½ volts. Output from the crystal is fed through pin 3 to the control grid of the pentode modulator. The triode oscillator, shown to the left of the common filament in the diagram, creates a carrier wave somewhere in the



Here's the miniature transmitter, including its power supply. The larger battery, bottom, provides 1½ volts for the heater; the smaller unit above it is the tiny 22½-volt plate supply.

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broadcast band. This wave, modulated by the output of the crystal, is radiated to a nearby receiver and there tuned in as if it were a regular broadcast signal.

Across the crystal cartridge is soldered a ½-watt 20,000-ohm carbon resistor. This relatively low value was found to be necessary because the output of the crystal was so great that it overmodulated the tube and caused considerable distortion. Depending upon the pickup used, you may find that you get better results with a higher or lower resistor value.

No socket is required for the tube since it is small and light enough to be supported by its own wiring. Place it directly behind the crystal cartridge, and make sure that it does not touch either the cartridge or the sides of the arm, since needle vibration might cause the tube to become microphonic. Tuning of the transmitter is accomplished by C2 and the secondary, or grid-to-ground, winding of L1. The former is a small padder condenser with a range of approximately 300 to 1,000 mmf., and the latter is a standard midget iron-core antenna coil, mounted directly behind the tube.

Oscillation within the tube is developed by the feedback coupling between the two windings of the coil. Just to preclude the possibility of any wiring touching the metal of the arm, line the inside with two or three layers of cellulose tape before you start.

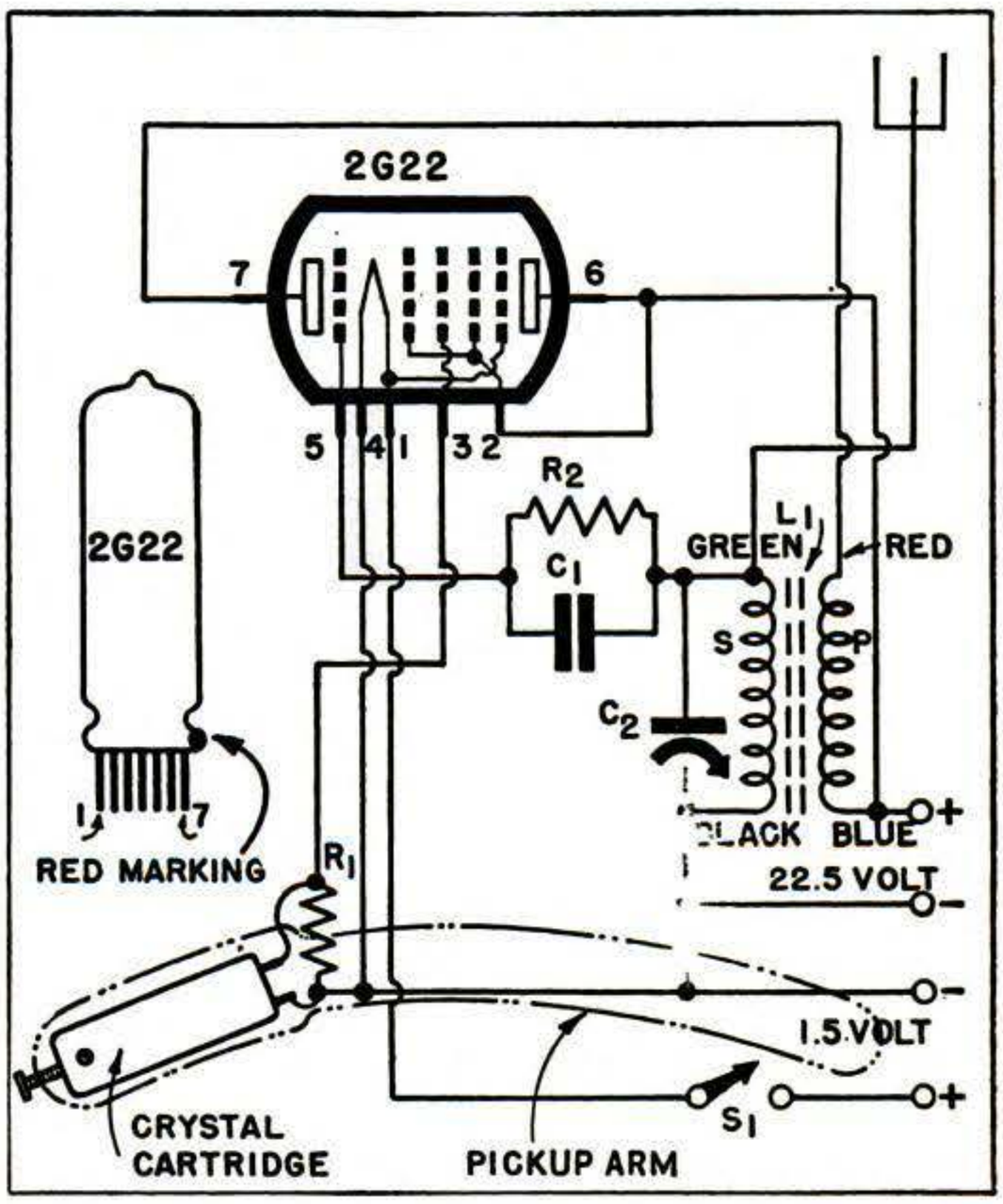
The padder is mounted through a hole in the arm so that the capacity-adjustment screw is accessible through the top. This allows you to vary the frequency until the signal comes in at a blank spot on the radio dial. For the antenna lead, use a 20′ hank of wire. Bring it close to the antenna lead-in of the radio, but do not connect them electrically.

Phono Strip Amplifier

For beginners in electronics, Homer L. Davidson has worked out this one-evening project. You'll be surprised at the results you can get from a pint-sized amplifier that uses only five condensers and four resistors, yet gives you independent control of both volume and tone.

Again the tube selected serves a dual purpose. The 117L7-GT is both amplifier and power rectifier. Constructed on a thin strip of composition board, the amplifier can be mounted in any position inside the box that houses the phono motor and turntable. First drill a 1⅛″ hole to receive the octal

A painted radio chassis holds the phono motor and batteries; the rest is under the tone arm.



LIST OF PARTS

R1: 20,000-ohm, ½-watt carbon.

R2: 150,000-ohm, ½-watt carbon.

C1: 100-mmf. mica.

C2: 300 to 1,000-mmf. padder.

L1: Unshielded iron-core antenna coil.

S1: SPST toggle (or DPST to connect phono motor simultaneously).

Crystal pickup, 2G22 subminiature tube, 20′ hank of antenna wire, 22½-volt B battery, 1½-volt A battery, misc. hardware.

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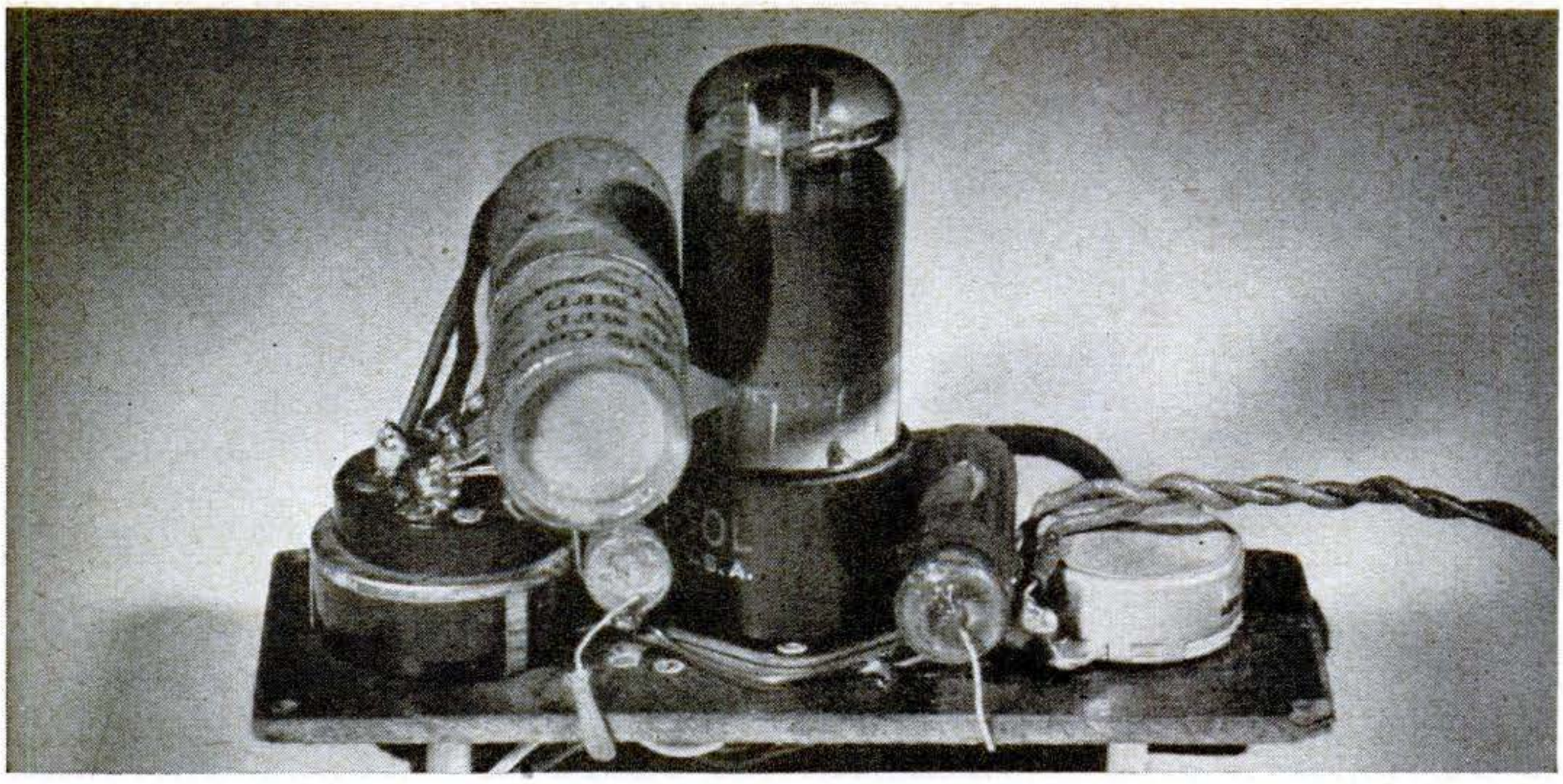


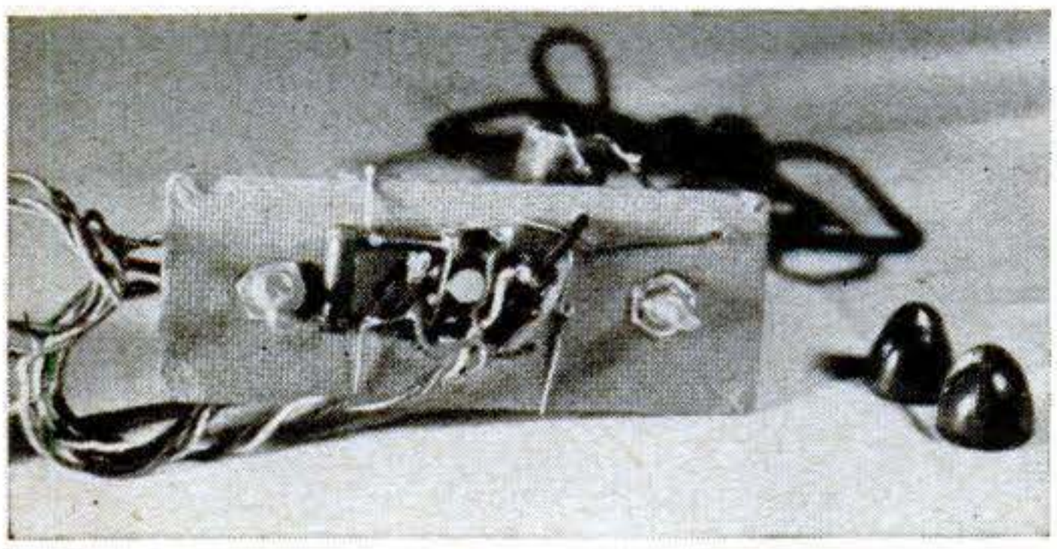
A dual-purpose rectifier and beam-power tube makes this compact amplifier possible. A strip of nonmetallic material such as bakelite, plywood, or composition board serves as chassis.

socket. If you don't have the right size drill, make smaller holes and file out the opening. Install the two variable resistors, one on each side of the socket, with their shafts facing in the opposite direction from the tube. Using spacer washers, you will then be able to screw the strip to the inside of a cabinet or panel so that the controls will be easily accessible.

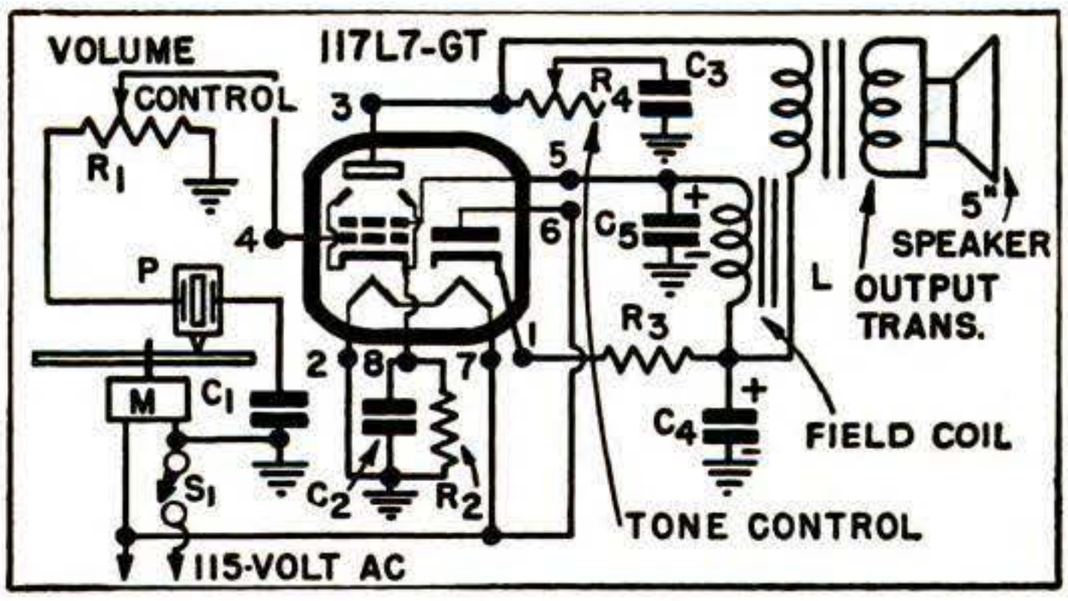
A dynamic speaker was used, and its field coil became the filter choke. In addition to this coil, the filter employs a dual 40-mfd. electrolytic condenser or two separate condensers of equal value. If you have a 5″ permanent-magnet speaker, you can use that instead of a dynamic unit by substituting a 3,000-ohm resistor in place of the field coil. Filtering action, however, will not be as smooth.

High Input Yields High Output

With one of the new pickups that give between four and five volts of signal strength, you can get very substantial room



Control shafts project through panel bottom and can be brought through front of cabinet.



LIST OF PARTS

R1: 1-meg. potentiometer.

R2: 150-ohm, ½-watt carbon.

R3: 25-ohm, 5-watt wire wound.

R4: 50,000-ohm pot.

C1, C3: .05-mfd., 400-volt paper.

C2: 10-mfd., 25-volt electrolytic.

C4, C5: 40-40 mfd., 150-volt dual electrolytic.

L: 2,750-ohm field coil on 5″ electrodynamic speaker.

S1: SPST rotary on R1.

Output trans., 117L7-GT tube, crystal pickup, phono motor, misc. hardware.

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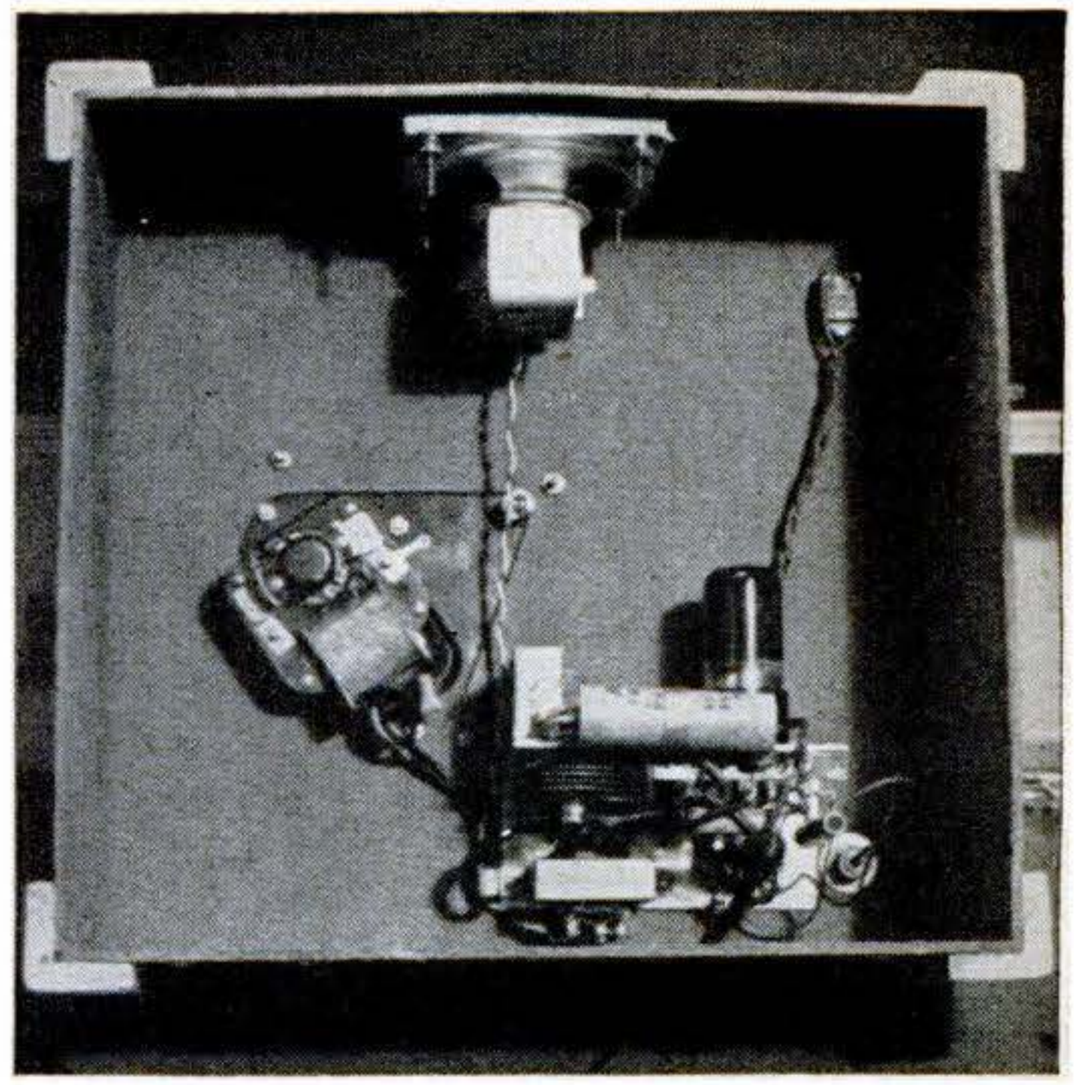
A simple cabinet, made of composition board, completes this one-evening phonograph project.



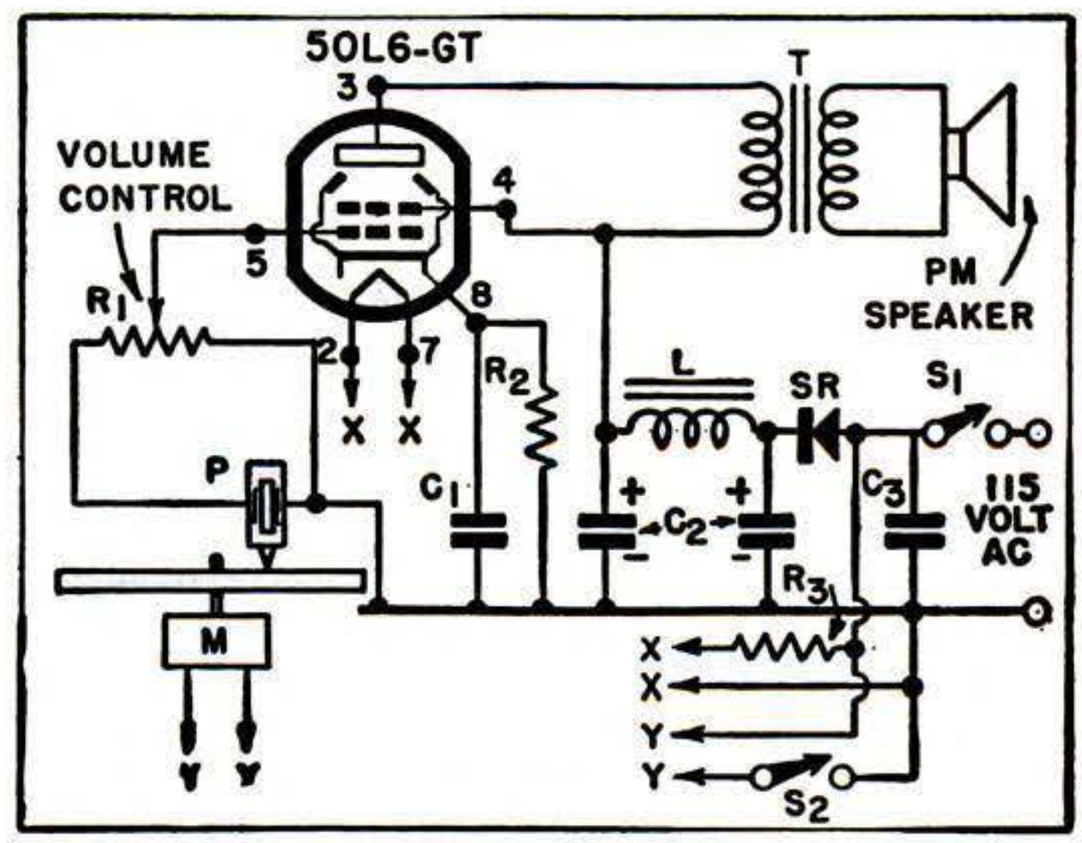
Position of components is optional. Drill one or two holes under turntable for ventilation.

volume from this one-tube amplifier built by Clinton E. Clark. As shown in the diagram at the right, the output of the crystal is fed directly to the control grid of a 50L6-GT beam-power pentode. Filament voltage for the tube is taken from the 115-volt line through dropping resistor R3, and in place of a separate rectifier tube, a new selenium stack is used in the power supply. The cabinet is built up from composition board.

Assemble the parts on an aluminum or steel chassis about 5″ by 6″. All ground connections in the unit shown were brought to a single point on a terminal strip, but the chassis can be used for ground if that should prove more convenient. Either way, ground is connected to one side of the 115-volt line. The yellow or black terminal of the rectifier goes to one side of the line switch, S1; the red side to the input of filter choke L.

When you have determined the position of the chassis but have not yet mounted it in the cabinet, drill one or two ventilation holes to carry off the heat generated in the tube. If properly placed, these holes will be concealed by the turntable. To avoid any possible damage to the pickup, install it after all other parts are in place.

The miniature oscillator is battery powered, but the other two circuits will work equally well on AC or DC. Although AC input is specified in the diagrams, this is only because the motors are connected to the same line. If you have DC, you can substitute a suitable electric or spring-wound motor. END



LIST OF PARTS

R1: 500,000-ohm linear-taper potentiometer.
R2: 200-ohm, 1-watt carbon.
R3: 500-ohm, 20-watt wire wound.
C1: 25-mfd., 25-volt electrolytic.
C2: 20-20 mfd., 150-volt dual electrolytic.
C3: .01-mfd., 400-volt paper.
SR: 100-ma. selenium rectifier.
L: 15-hy., 40-ma. midget AC-DC choke.
T: Midget universal output trans.
S1: SPST rotary on R1.
S2: SPST toggle.
Phono motor, high-output (4-5 volts) pickup, 50L6-GT tube, PM speaker, misc. hardware.

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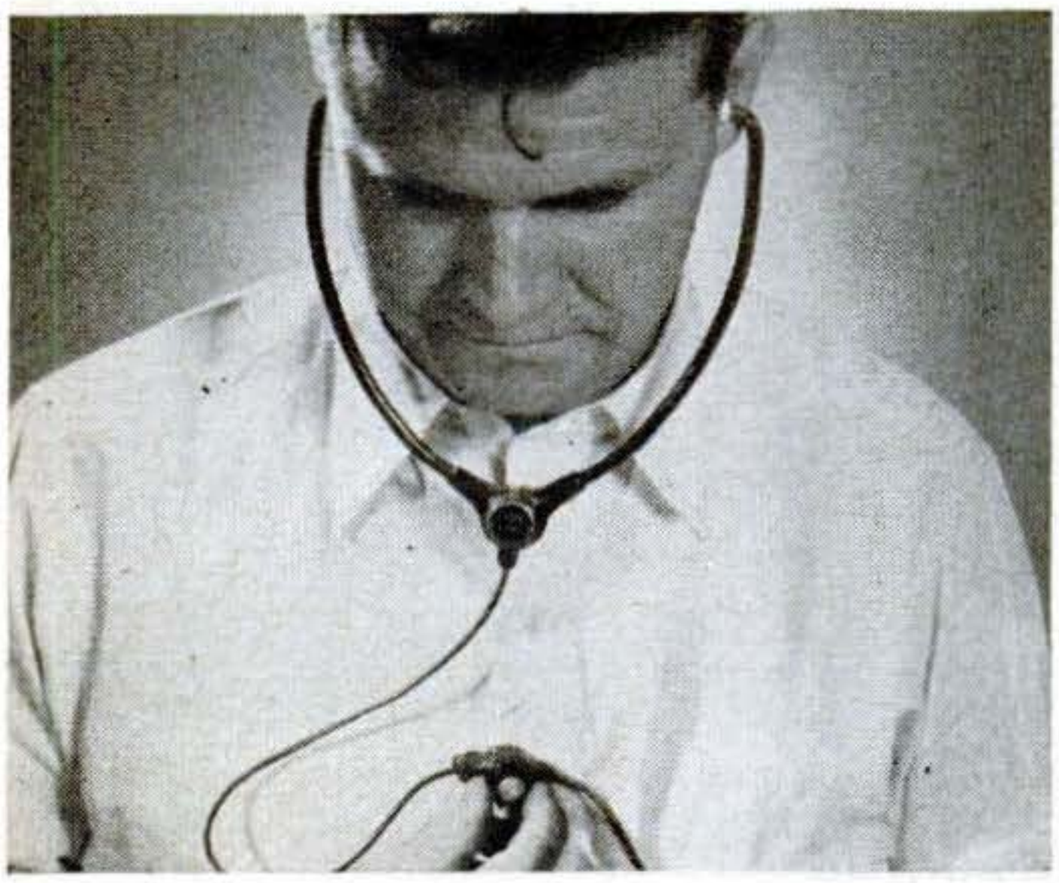
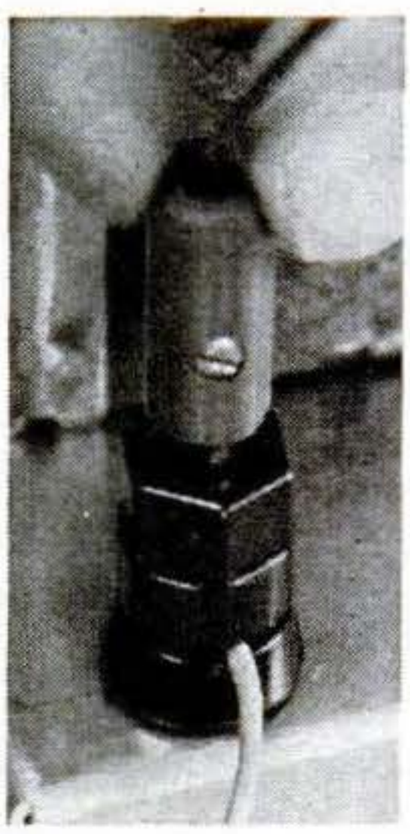
NEWS IN ELECTRONICS



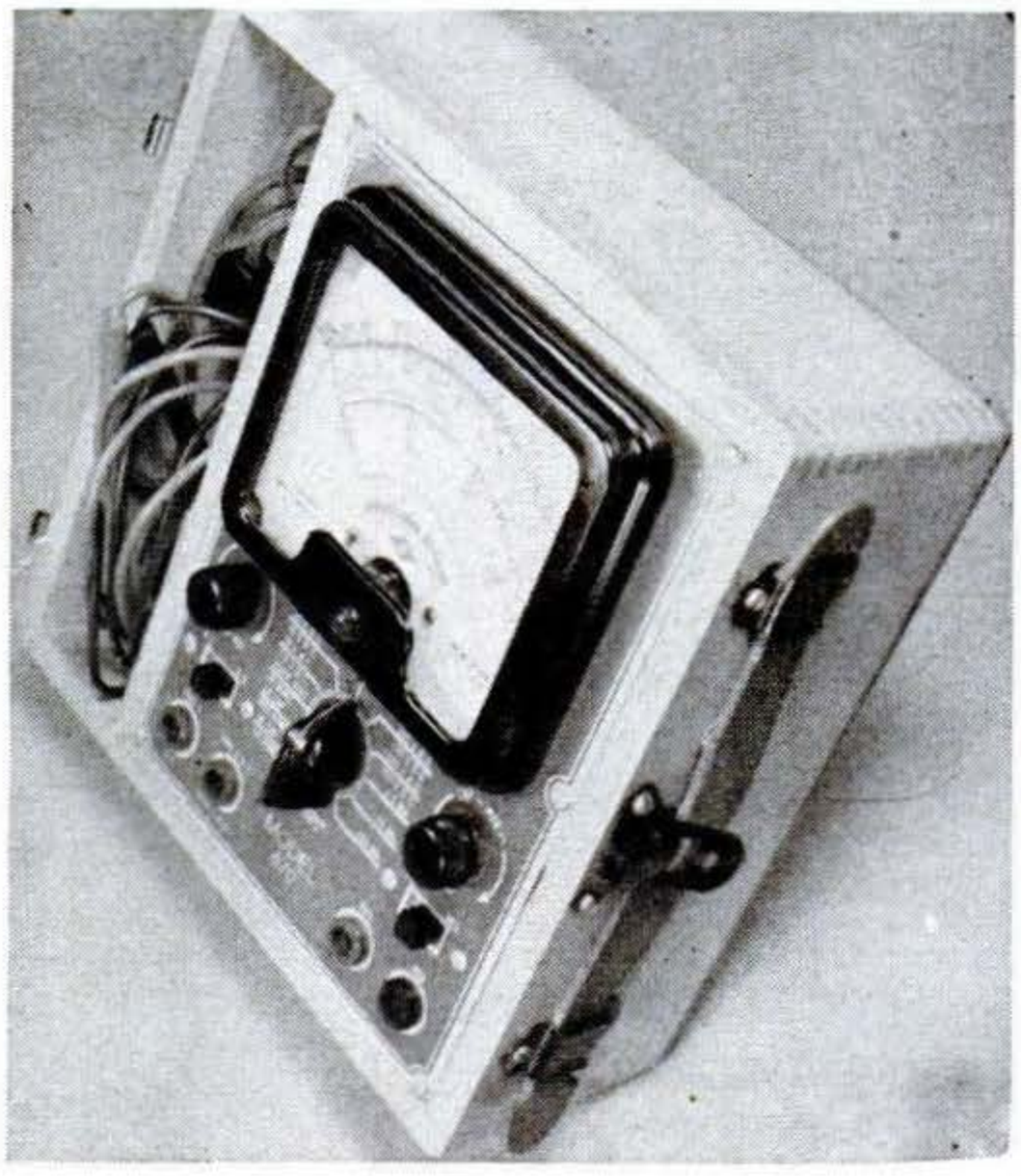
Headset Volume Is Adjustable. Sound level can be controlled by the user of this new under-chin headset made by Telex, Inc., Minneapolis. A volume control that may be clipped to tie or shirt front is provided with the unit.

Antenna Support. A stand-off insulator and support for vertical whip antennas used with mobile and marine equipment is being manufactured by Printloid, Inc., New York. The supporting insulator is machined from clear plastic and may be attached anywhere above the base of the antenna shaft.



Binding Post. A new electrical connector made by the Superior Electric Co., Bristol, Conn., consists of a panel-mounting shaft with a screw-on head. With this off, a clip can be attached. Small wires may be clamped in a shaft hole, larger gauges or a spade lug looped around under the head. A banana plug fits in the top whether or not the cap is on.

Signal Tracer Built from Kit. Parts for a three-tube, battery-operated signal tracer are packaged as a kit by General Research Laboratories, Brooklyn. The same components are also merchandised as a built-up unit. Having loudspeaker output, the tracer can be used as a portable amplifier when desired.



Multitester Checks Capacity. Beside the usual volt, ohm, and current indications, this new multimeter will give direct reading of capacitance (.001 to 4 mfd.), inductance (1.75 to 8,000 henrys), decibels (−10 to 58 db.), and reactance (750 to 3,000,000 ohms). Superior Instrument Co., New York, sells it for around $30.

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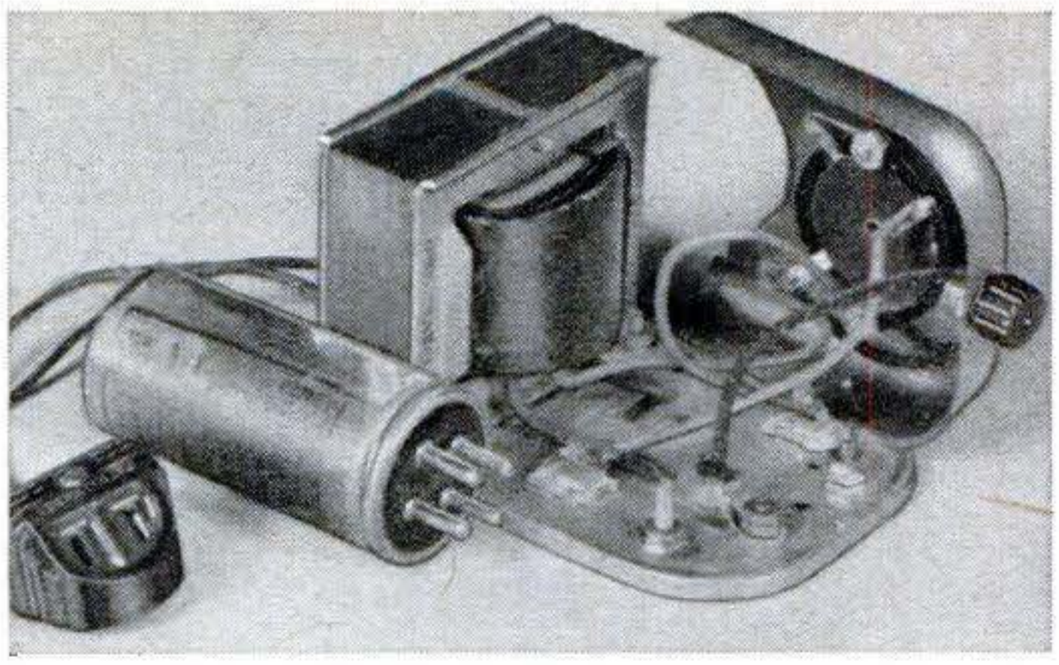
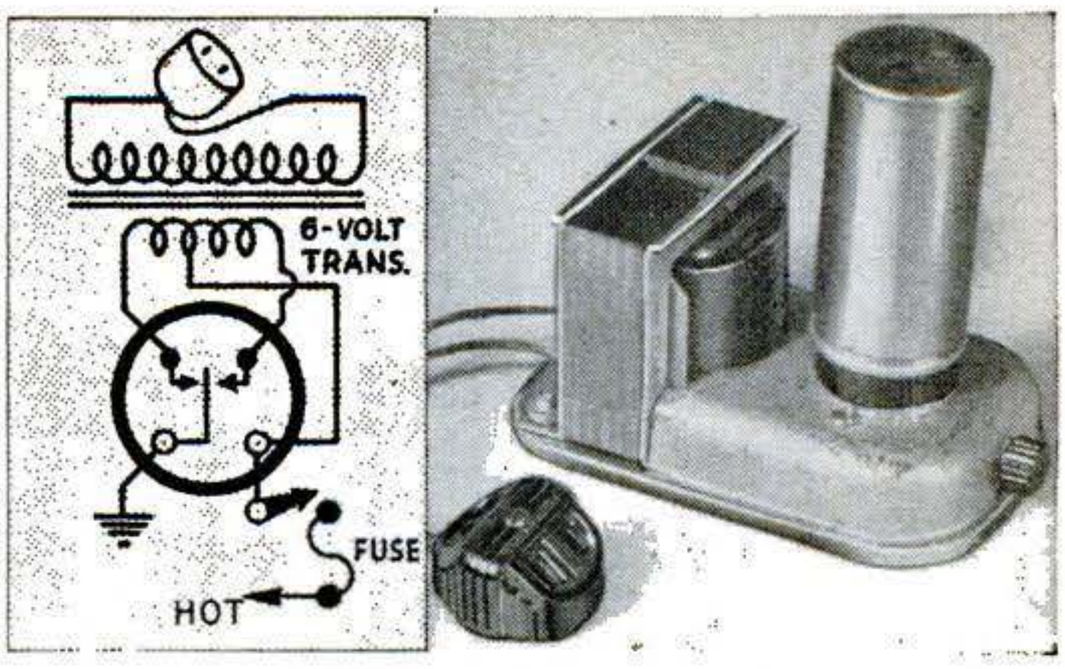


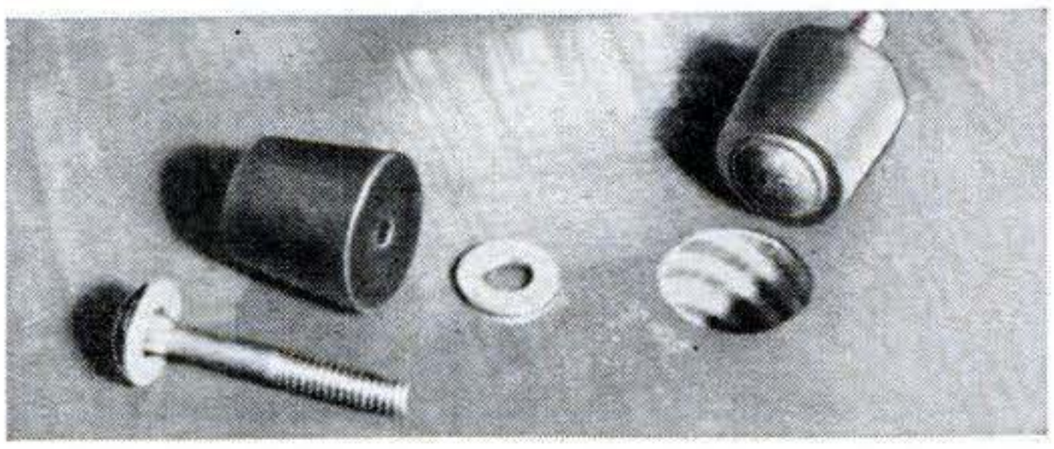


Converter Furnishes Line Voltage to Your Car

MANY electrical appliances would be especially handy if you could use them in your car. An electric shaver or small radio drawing up to 25 watts will work off the 115-volt output of this converter. A 6-volt filament transformer with center-tapped secondary is used in reverse so that the 6-volt winding becomes the primary. A switch, outlet, and nonsynchronous auto-radio vibrator are wired as shown. Connect the ground side to any body nut and the hot lead to a convenient switch under the dash. Insert a 5-amp. fuse in the line as overload protection. The unit is assembled on a wood or metal plate and mounted in the glove compartment.—A. J. BRAULT.

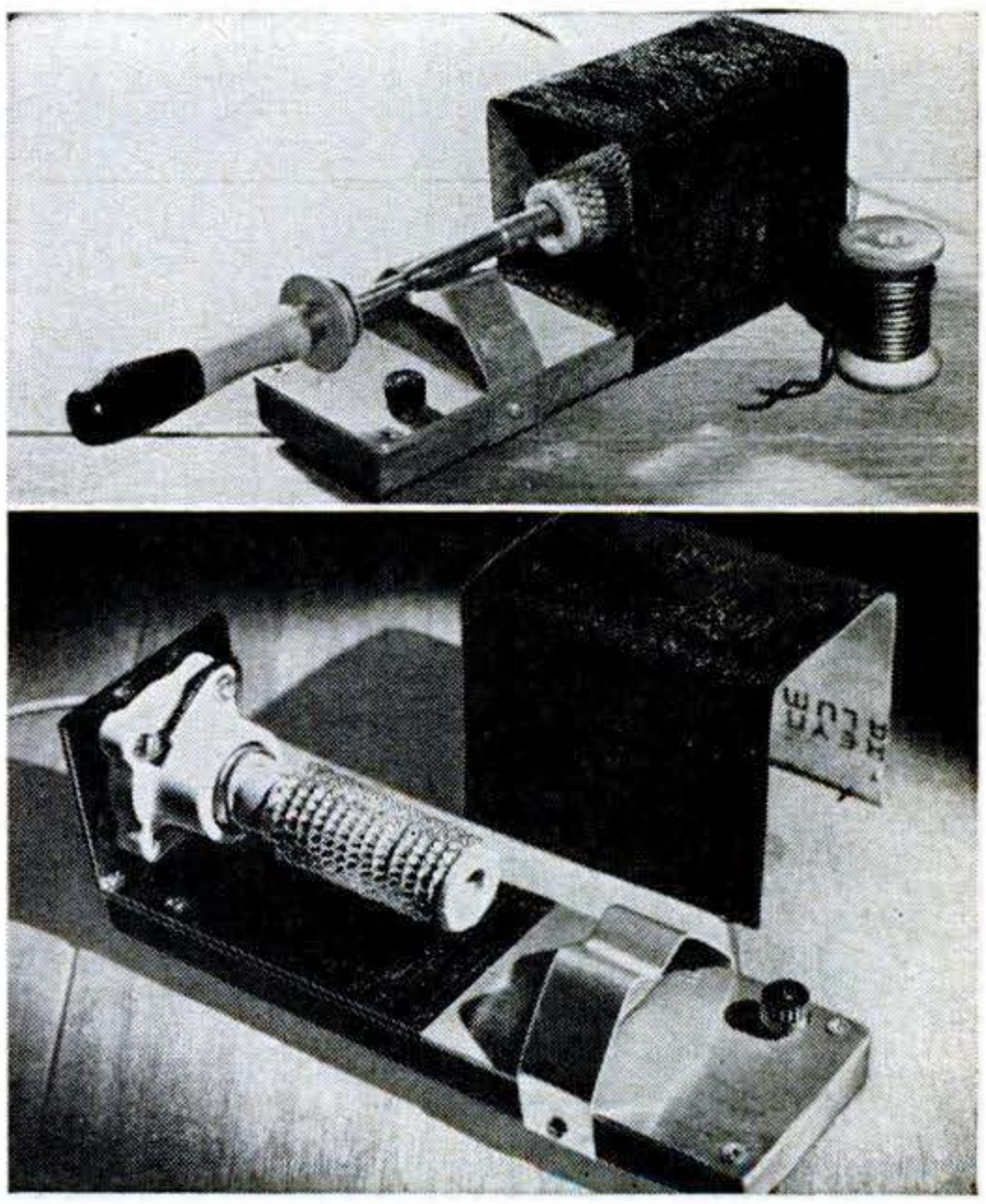
Painted Lamps Reflect Light

ORDINARY lamps up to the 150-watt size serve as reflector floods if you coat them with aluminum paint. Best results are obtained with the type made by mixing the metallic powder in a vehicle of thin shellac.—KENNETH MURRAY.



Rubber Feet Cut Motor Noise

IF YOUR bench top acts as a sounding board for motor vibration, cushion the motor on expanding rubber plugs. A ¼″ carriage bolt with a washer under its head is driven through a No. 5 rubber stopper. Drill a 1″ hole in the bench for each bolt, making sure that the holes are deep enough to clear the boltheads. Insert stopper and bolt into the hole; the rubber will extend about ¼″ above the surface. When the motor is placed over the bolts and the nuts are drawn tight, the rubber will expand and seat securely in the hole.—ROBERT M. ROSE.



Furnace Heats Soldering Iron

QUICK heating and "wireless" handling are advantages of this simple soldering rig. Either a burned-out electrical iron with cord removed or one made for torch heating will do. A porcelain socket on an L-shaped metal base holds a screw-type heater element. I was able to find a 300-watt unit, which is preferable to the 550-watt type. Be sure that the tip of the iron cannot touch any wire leading to or inside the ceramic body of the element.—ROBERT WORTHAM.

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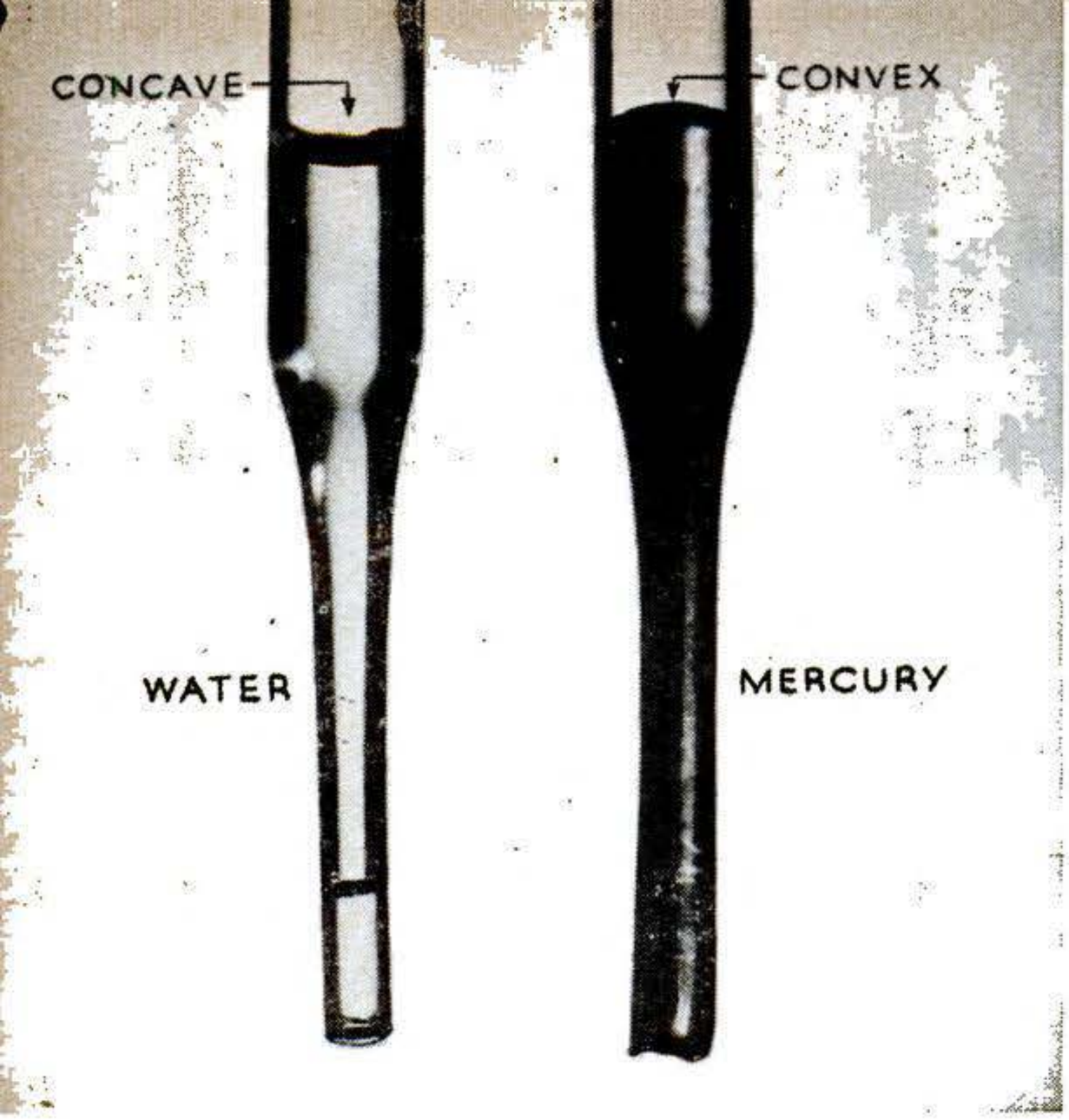
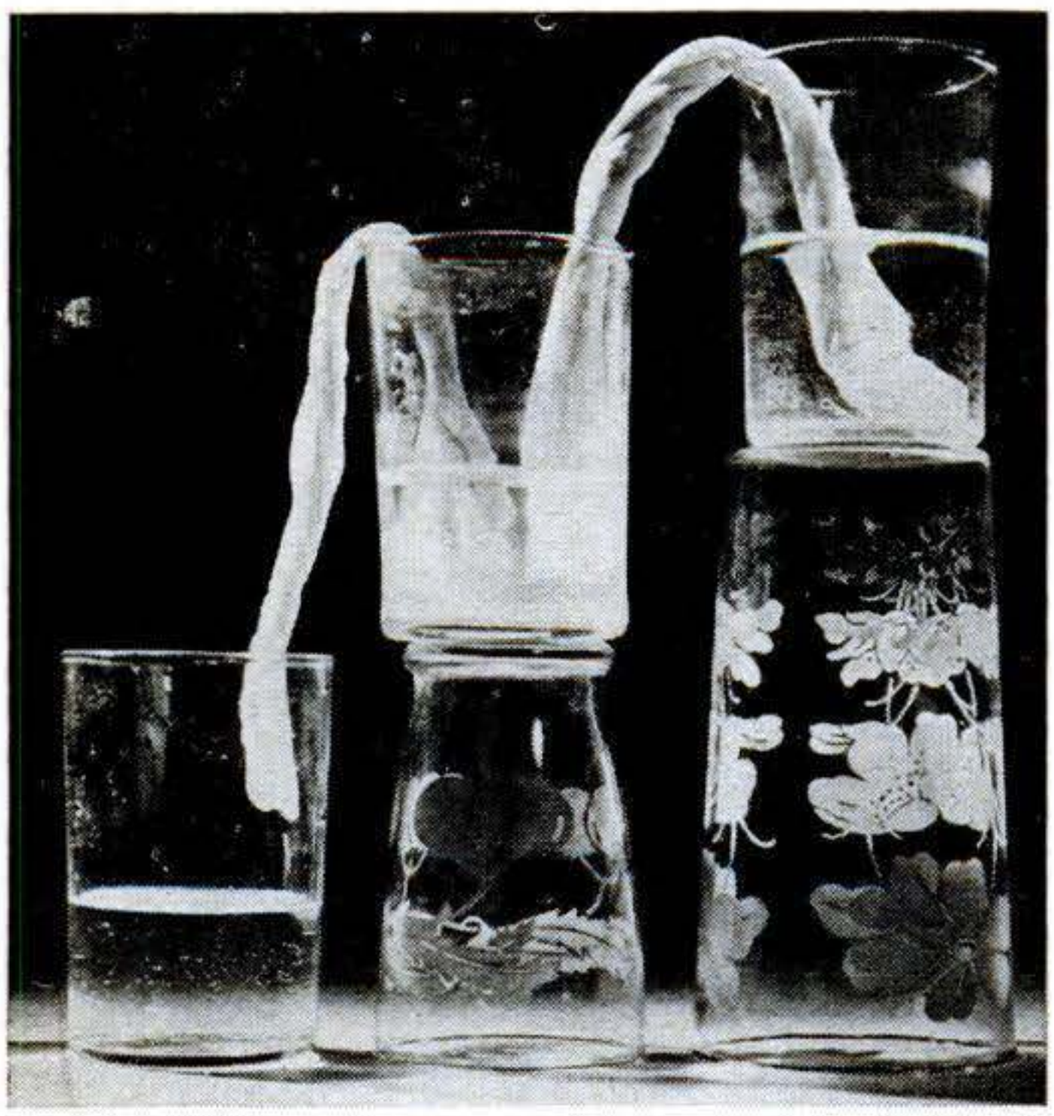


Fluids Don't Seek Same Levels. The old rule doesn't hold, for example, if a fluid is in a U-tube with legs of different diameter. Capillarity, which is the combination of surface tension and the adhesion (or lack of it) of the fluid to the tube, changes the rules. Water will stand higher in a narrow leg; mercury will stand lower.

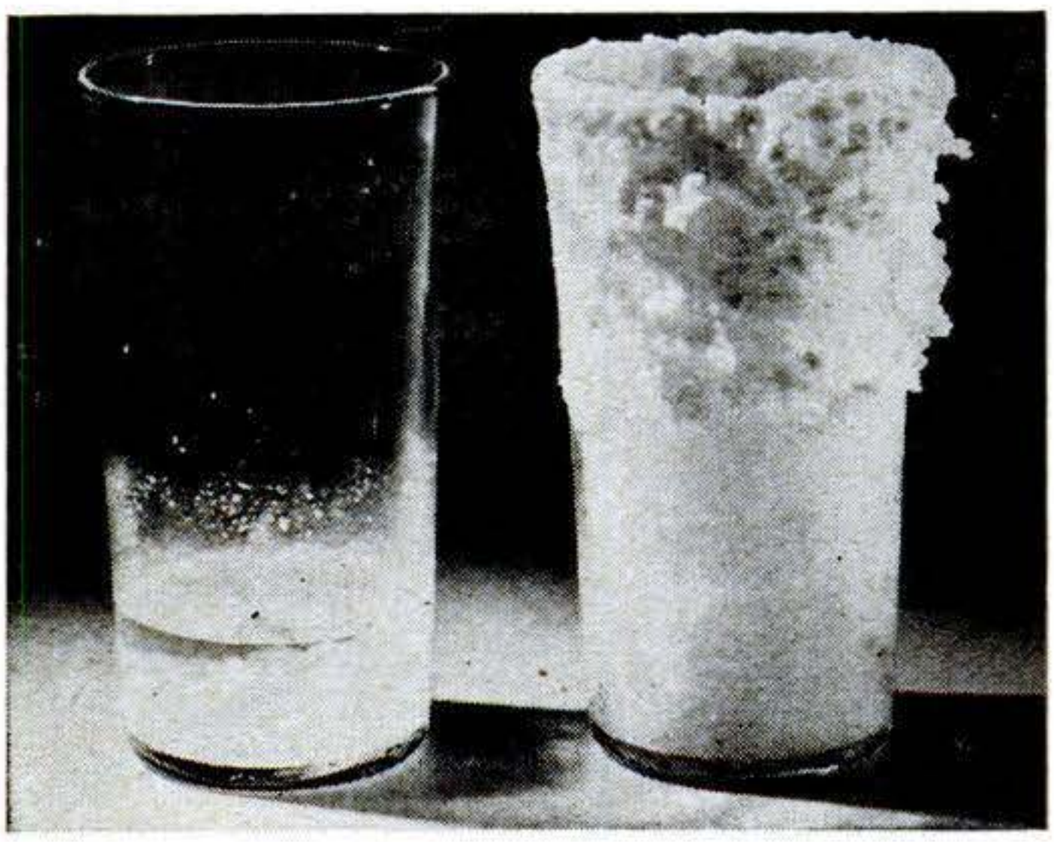
If you draw water and mercury into medicine droppers, the water surface will be concave, the mercury convex. Because the attraction of glass for water is greater than the cohesion of water molecules, water wets the glass and rises around the tube. Trying to flatten it, surface tension curves the surface. Mercury molecules, however, are more strongly attracted to each other than to glass. Hence the action reverses.

How Capillarity Pulls Fluids Uphill



Fluid Separated from Solid. In the 7th Century, an alchemist named Geber described a capillary filter by which a liquid could be separated from a solid. You can demonstrate this principle with three glasses mounted as shown and connected by two lengths of twisted cloth.

Wet both cloths with plain water. Then half fill the top glass with a solution of calcium chloride and the middle one with a solution of sodium carbonate. Capillary action soon starts siphoning the calcium chloride solution from the top glass to the middle glass. There it combines with the sodium carbonate, forming a white precipitate of calcium carbonate. Since the latter is insoluble, it does not rise on the lower cloth, and the latter carries a perfectly clear fluid to the bottom glass.



Crystals Climb from Glass. It is capillarity that causes crystals to climb out of containers of saturated solutions. This process begins when a ring of solution forms around the vessel at the edge of the surface. Liquid from the top edge of the ring evaporates, leaving a row of tiny crystals. These act as capillary tubes, causing the liquid to rise higher. The process repeats until the crystals have climbed out of the container. This may be prevented by making the inner surface of the glass water-repellent—say by smearing a ring of petroleum jelly around it, as at the left.

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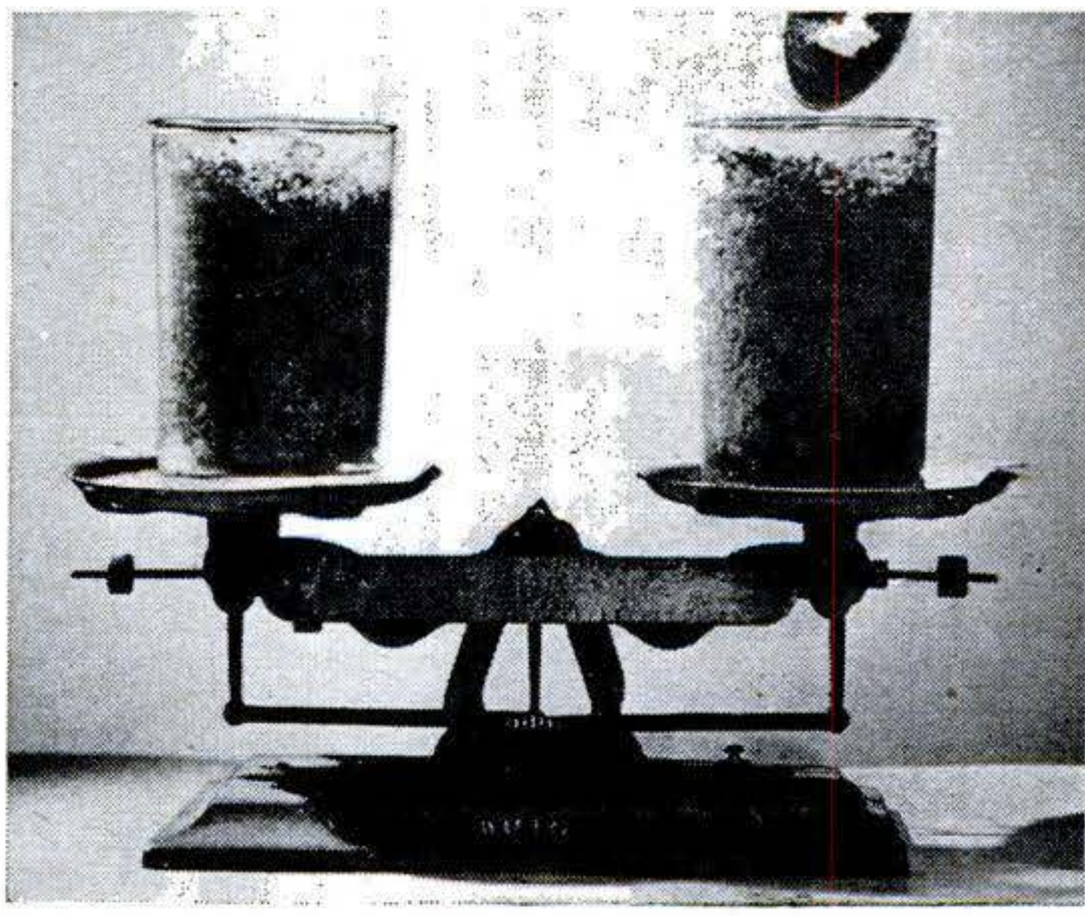
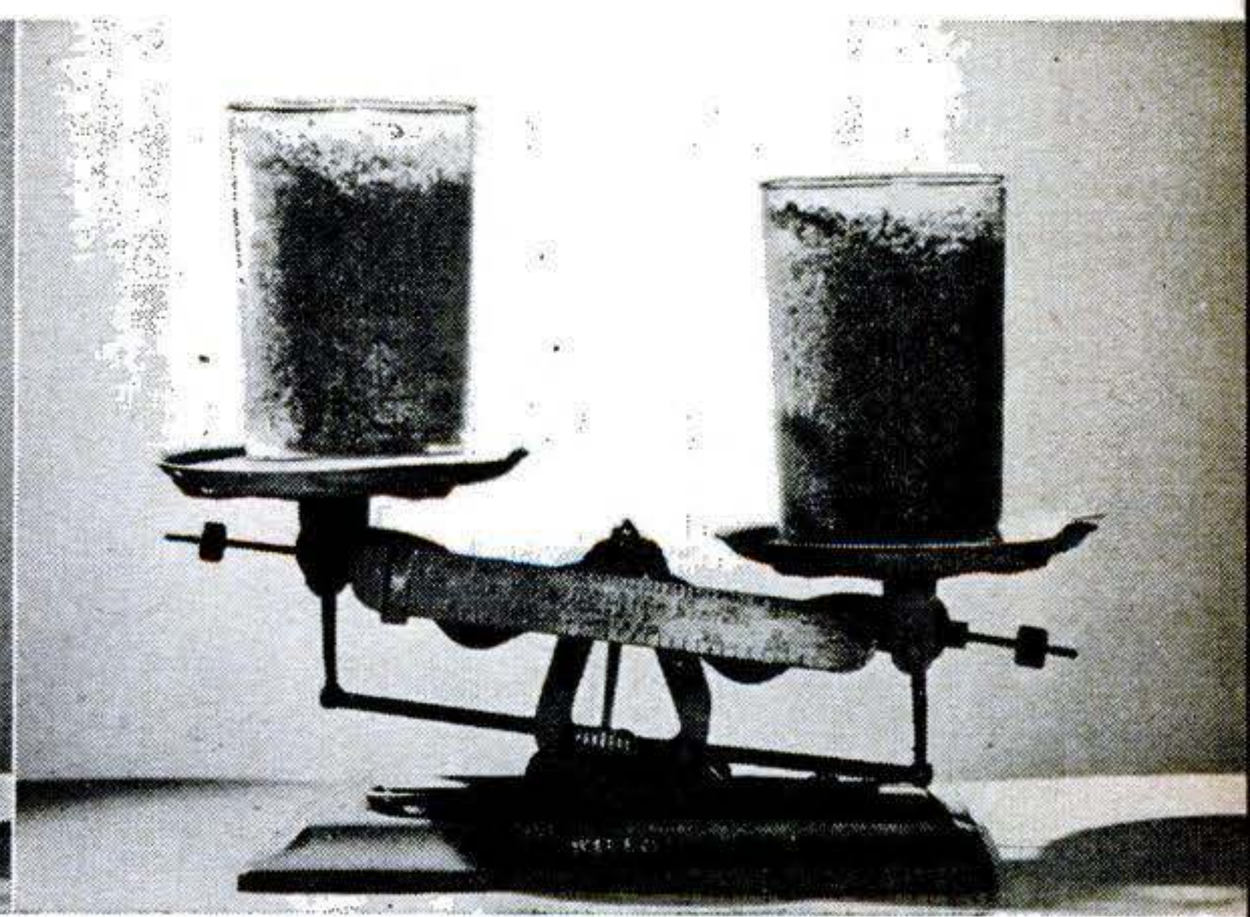
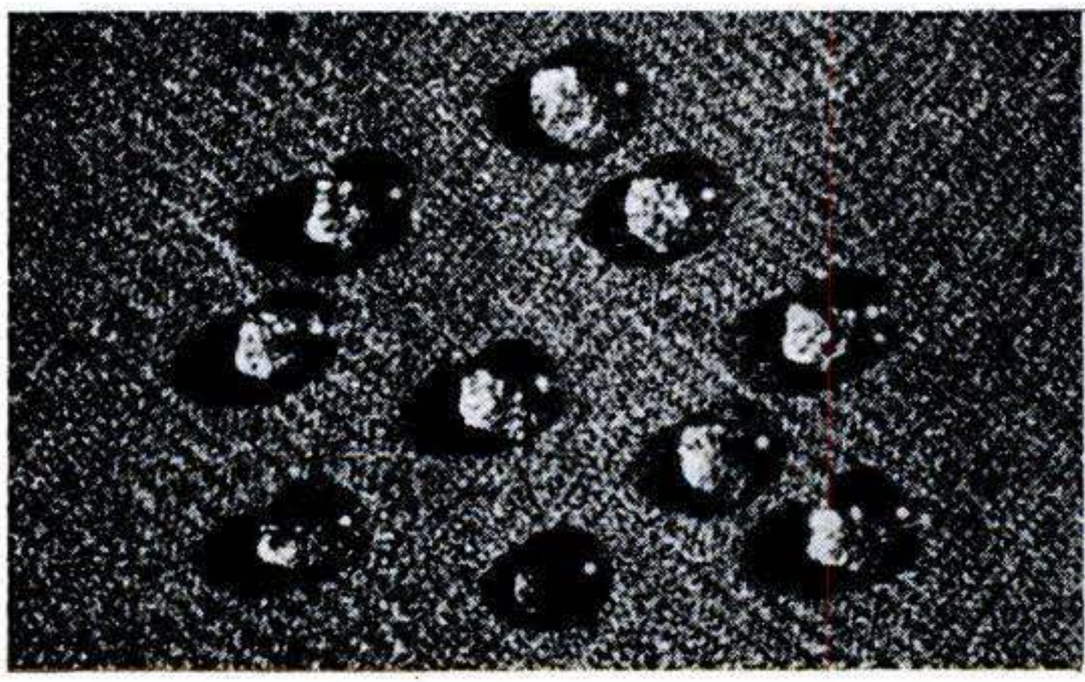
Water Stays Upside Down. Although capillarity causes water to soak cloth, surface tension often prevents it from leaking through. This may be demonstrated as at the right. After pouring water in the glass, smooth a piece of old handkerchief, thoroughly wet, over the mouth, making certain that the cloth touches the glass at all points. Then, with your hand over the cloth, invert the glass and carefully remove your hand. Air pressure holds the cloth, and surface tension prevents seepage.

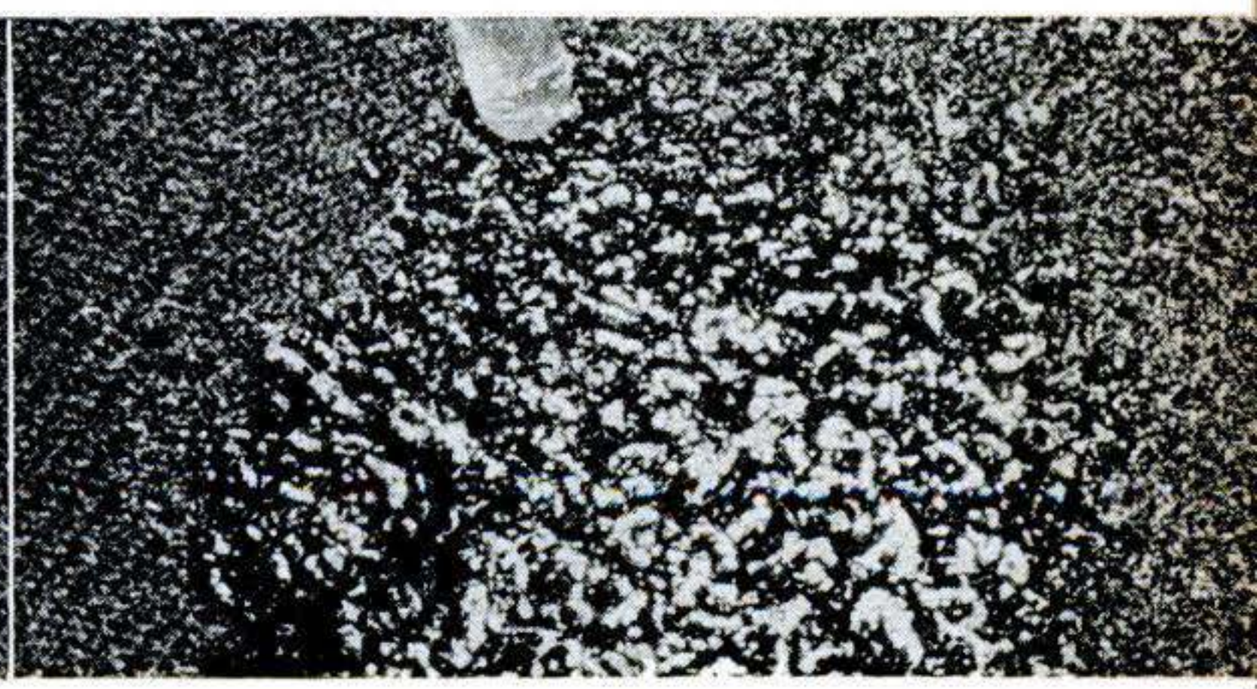




Capillarity Dries Soil. You can demonstrate an important principle of farming and gardening by putting equal amounts of the same kind of soil in two glasses on the pans of a balance. Add an equal small amount of water to each and pack both down slightly and equally. Then loosen the top half of the soil in one glass with a spoon. Examine the glasses periodically and you will find that the one with the packed soil gradually becomes lighter because moisture rises to the surface and evaporates. In the other, capillary action is retarded and the soil retains its moisture.

Water Repellency Overcome. Cloth that repels water is excellent for raincoats, but this action is desirable only in the finished material. To reduce water-repellency during dyeing and other processing, textile manufacturers resort to all kinds of "wetting agents." At the left below, you see how drops of water stand up on an ordinary woolen fabric. Because of repellency, capillary action does not take place. But if you add a drop of wetting agent, such as one of the products sold for photographic use, the water is immediately absorbed into the material, as at the right.





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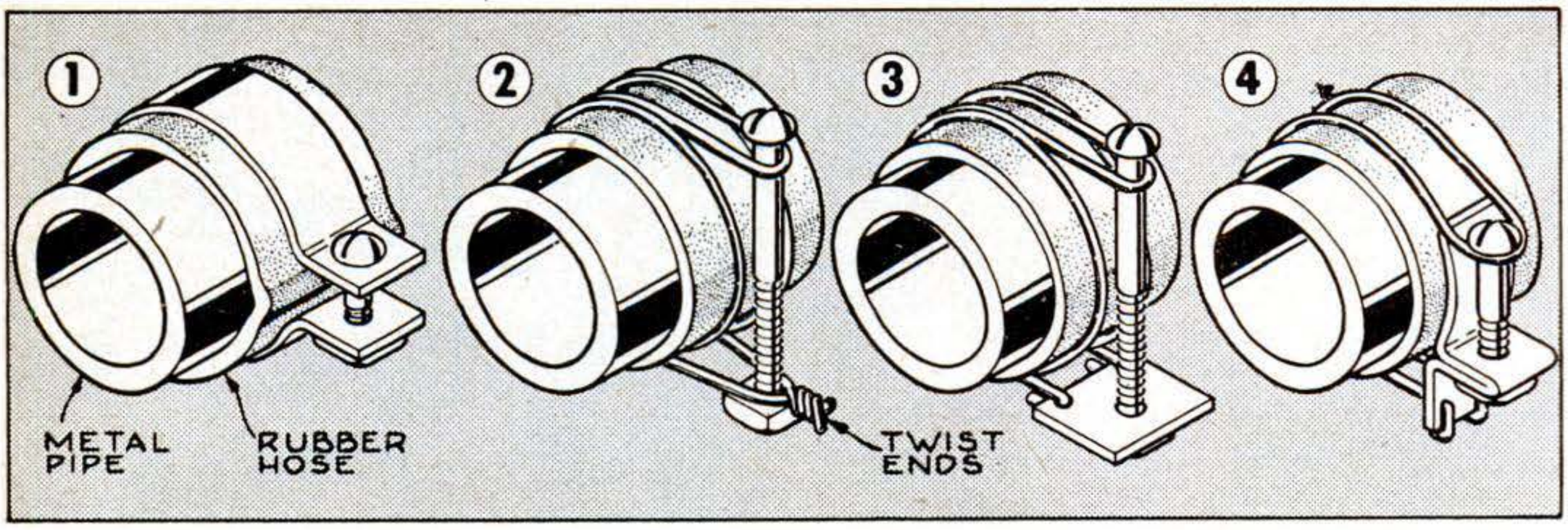
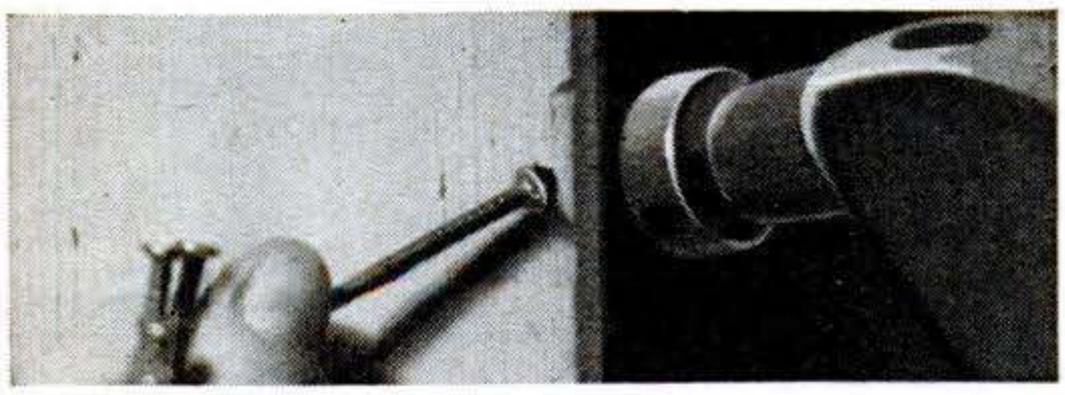


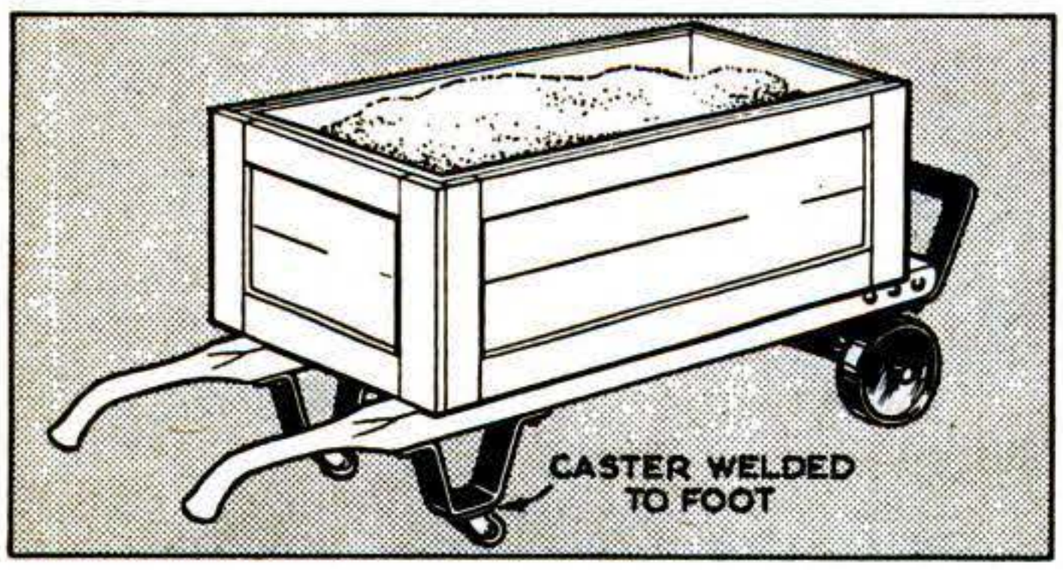
Hose Clamps Improvised from Wire and Bolts

HOSE clamps of the type shown in Fig. 1 sometimes let the hose bulge near the screw. Often a good clamp can be devised with wire and a machine screw, as in Fig. 2. Since the wire loop is wrapped around twice, it exerts clamping pressure at all points. A drilled square washer of the kind shown in Fig. 3 is one refinement, and a piece bent from stiff metal as in Fig. 4 will protect the hose from possible damage by the screw threads. One advantage of making hose clamps from wire is the fact that they can be accurately fitted to hose diameter.—EMILIO BORGELESI.



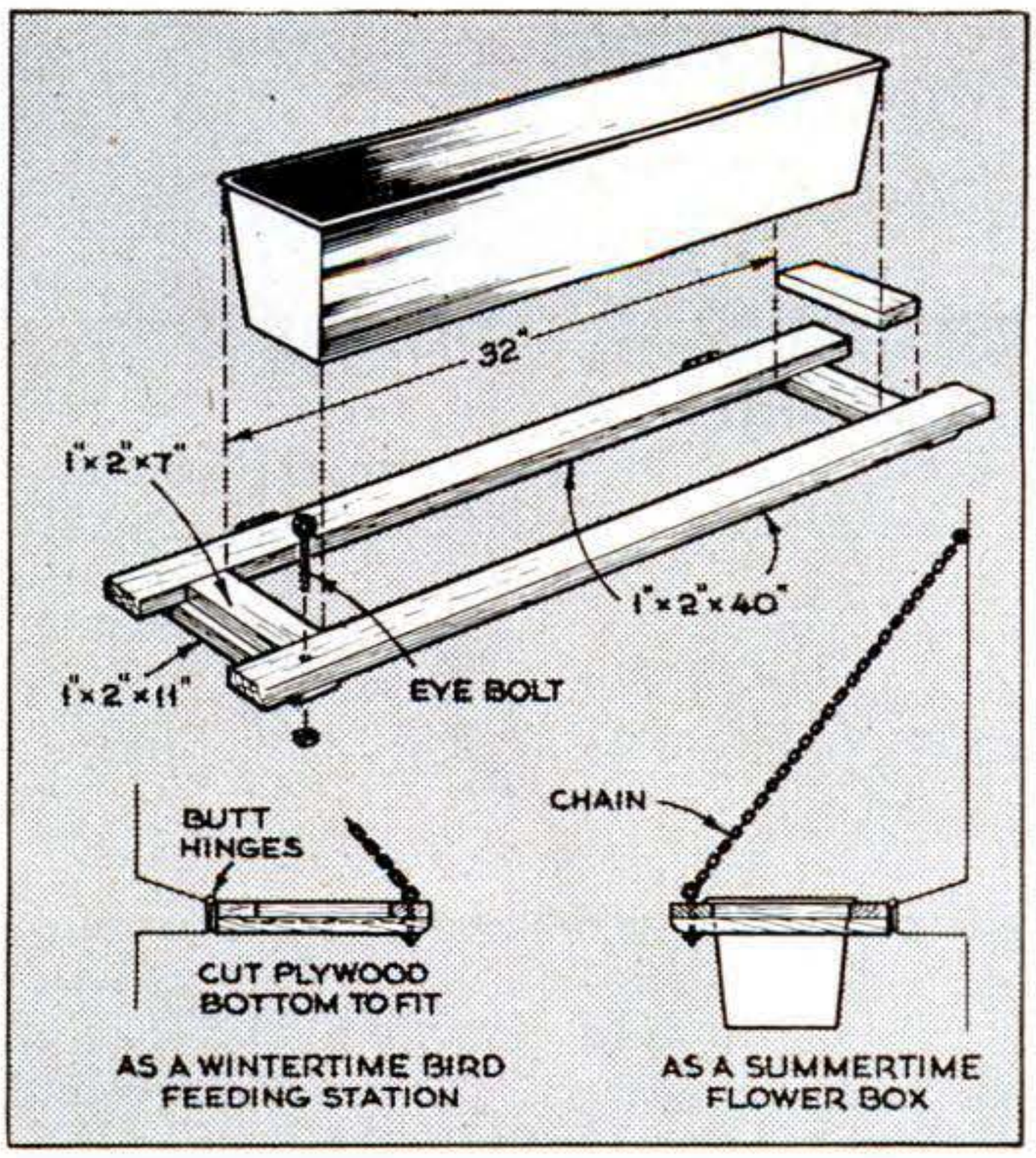
Nail Head Used as Nail Set

WHEN you are doing rough carpentry work, one of the nails that you are using will serve as a nail set. Simply place the edge of the head against the head of the driven nail and hammer it down.



Casters Improve Hand Truck

IF A pair of heavy casters is welded to the rear legs of a hand truck, it may then double as a flat truck when heavy loads must be moved considerable distances across the floor. The weight need not be lifted and no balancing effort is involved. Neither is there any chance that small objects will fall from the truck.—ANDREW VENA.



Plant Box Is Also Bird Station

ONE of winter's most forlorn sights is the window box that holds only straggly wisps of dead plants. The sketches above show a support that may be detached from the window casing for storage, or converted into a cold-weather bird station.

The frame is attached to the sill by butt hinges. Chain supports from the upper window casing are held by eye bolts. For a bird station, simply remove the standard metal flower box and screw in a panel cut from waterproof plywood.—C. E. LAMOUREUX.

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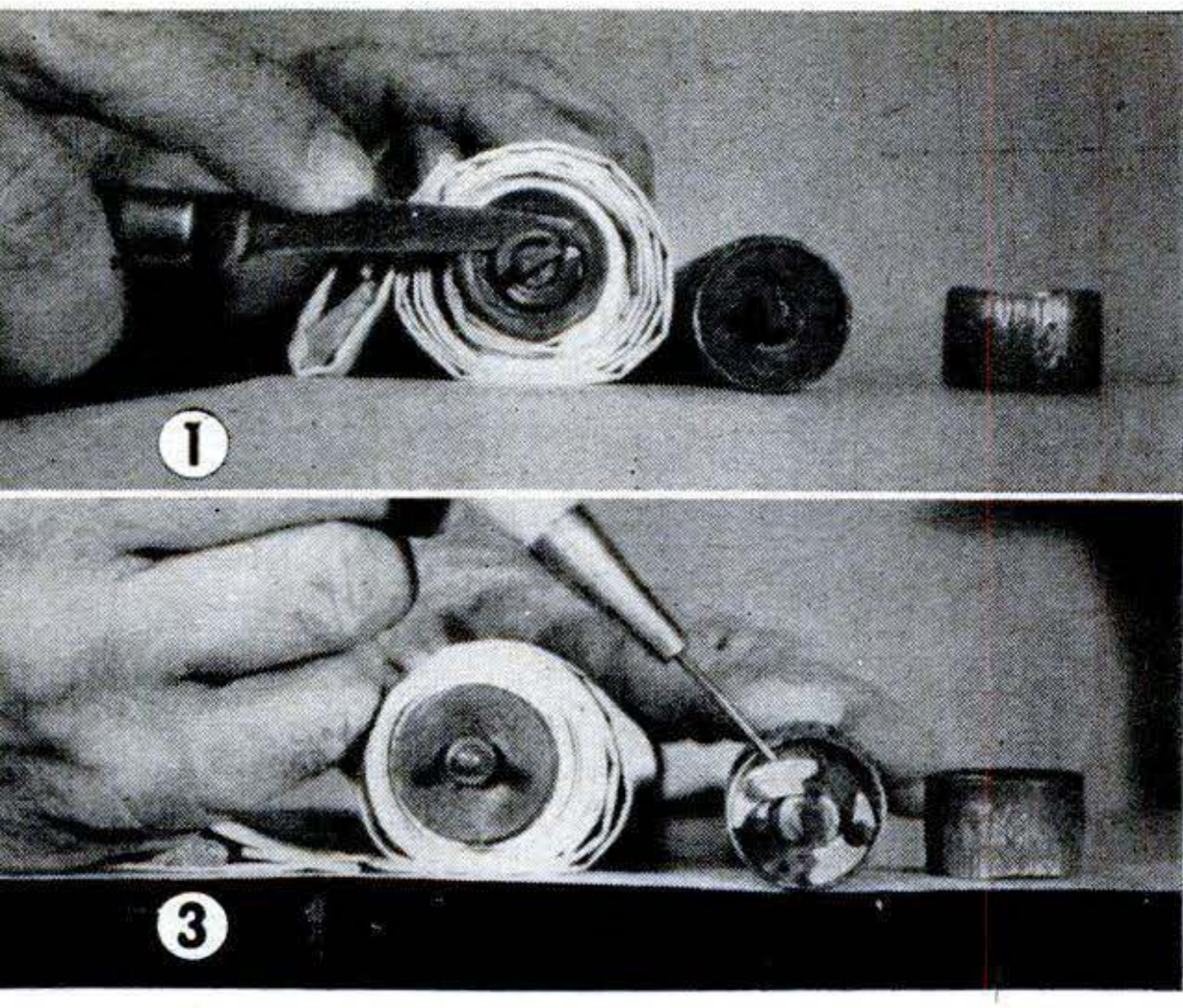


Easily taken apart, a faulty window-shade roller may be restored to service by quick repairs.

Making That Shade Behave

EVEN though a window-shade roller is inexpensive, there's no reason why you should think only of a replacement in case of a breakdown. A little work will return most of them to service.

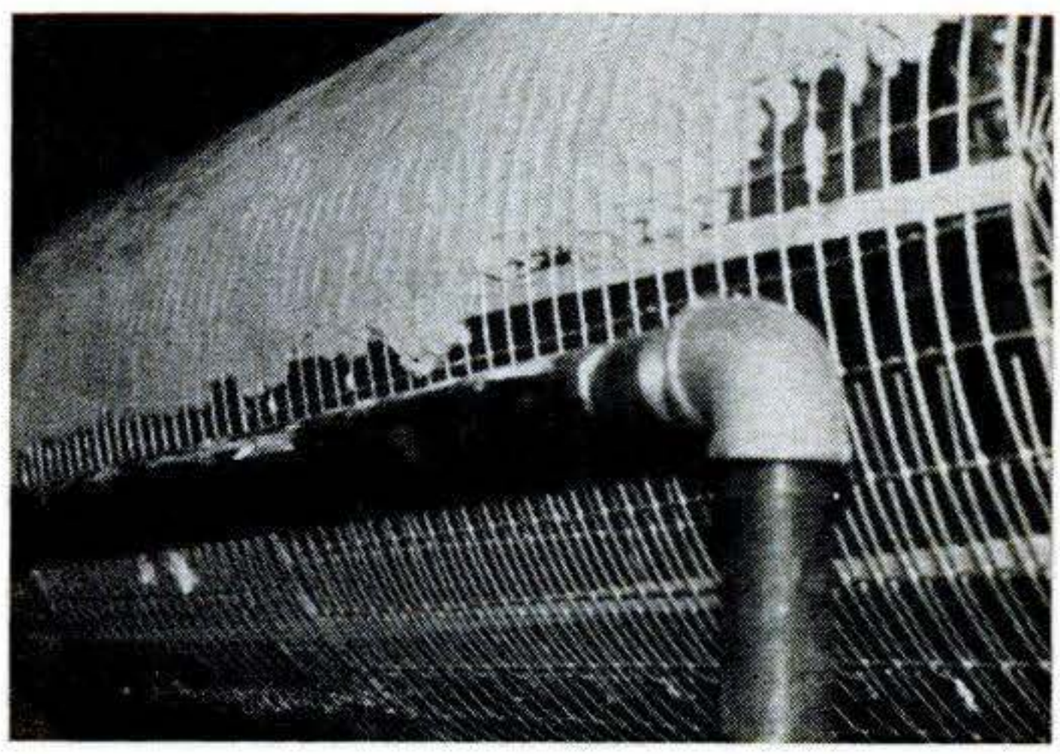
Some rollers have a dust cap that may be easily pried off (Fig. 1). The main cap also may be removed with a screwdriver and mallet (Fig. 2). This will reveal the pawls (Fig. 3). These are held away from the ratchet by centrifugal force when the shade is in operation, but their weight should make them engage when it is at rest. If they do not, clean them with an old toothbrush and carbon tetrachloride. Then work them back and forth. If they still stick, apply just a trace of oil.

If the spring doesn't work, remove the nail located about 9½" from the end, usually under the label, and withdraw the mechanism (Fig. 4). It may be that the nail allows the spring-carrying dowel to turn, that the spring is disconnected at one end, or that it is broken. Drive the nail back properly, reconnect the spring, or rebend and attach the broken end.

The other end of the roller has only a metal peg and cap. If you wish, this may be pried off and the roller sawed to fit a smaller window.—AL SCOTT.

Insulation Saves Hot Water

INSULATION may be applied to a hot-water tank as illustrated here. Draw wire netting loosely around the tank and join the edges. Tighten it around the tank by inserting thin wooden spacers at equal distances. These should hold the wire at least ¼" from the tank as well as keep it tight. With a trowel, apply a coating of asbestos plaster, leaving the surface rough. When this has dried slightly, apply a second. The second will be smoother if mixed somewhat wetter.



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Chemistry Predicts How Metals Will Act

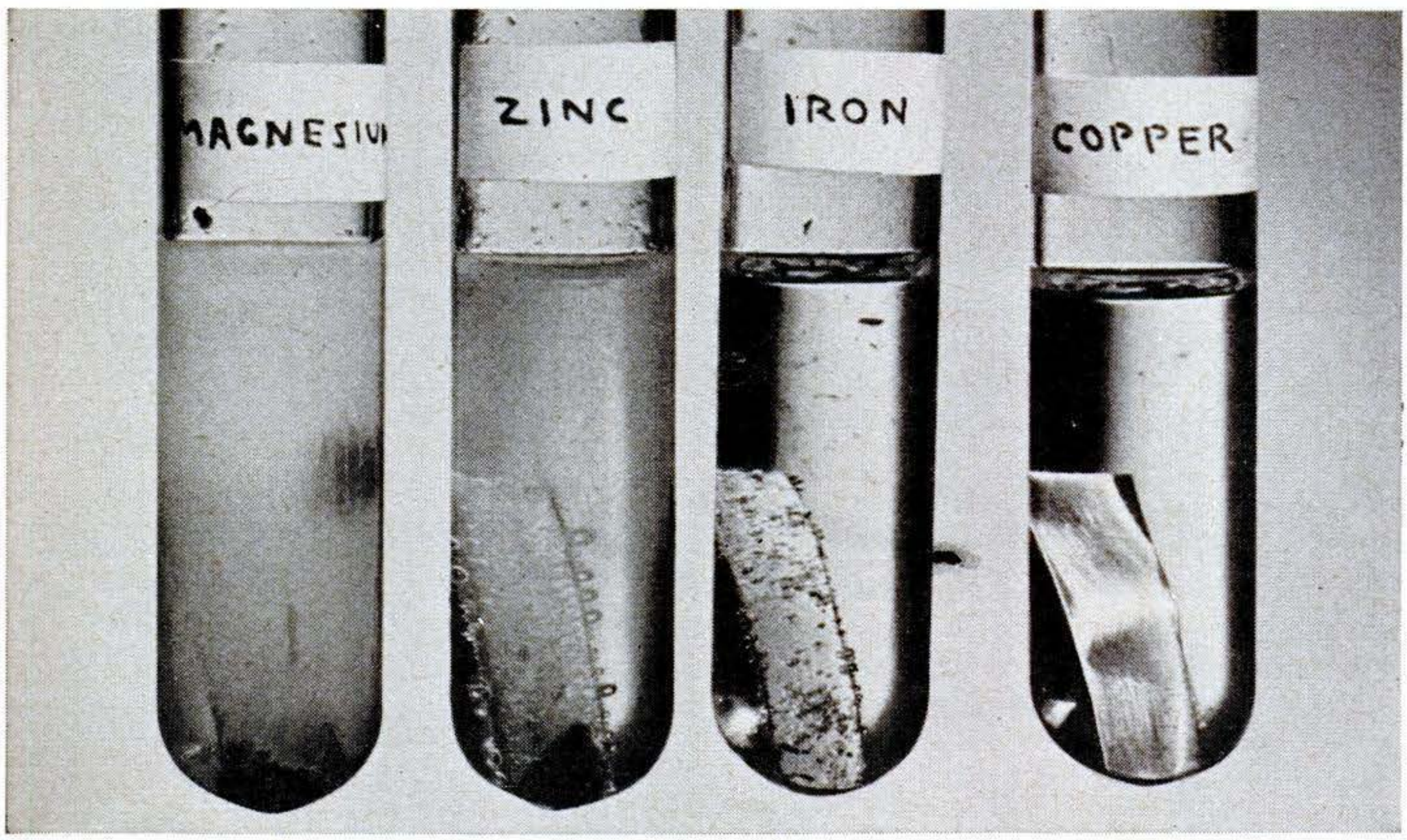
By Kenneth M. Swezey

SNAP on a flashlight, and you start a chemical reaction that produces electricity, heat, and light. Turn on the current in an electroplating tank, and electricity does a chemical chore, depositing a film of metal molecule by molecule. What is the link between test tube and electric spark? In large part it is found in the reaction of metals with other substances.

When a small piece of potassium or sodium is placed in plain water, the metal reacts violently with the water, releasing hydrogen so furiously that the gas often catches fire. Magnesium won't release hydrogen from cold water, but it will from hot water. Aluminum, zinc, iron, and tin can't displace hydrogen from water, but can from acids. Copper, silver, platinum, and gold won't set hydrogen free even from acids.

By elaborate tests, chemists have arranged all metals in a list according to the ease with which they enter into chemical reactions. This list, shown on the facing page, is variously called the activity series, the electromotive series, the electrochemical series, or the displacement series, depending upon the use for which it is intended.

Potassium, the most active metal, stands at the top; gold, the least active, at the bottom. Hydrogen acts much the same as a metal in displacement reactions and so is included as a guidepost. Any metal above hydrogen is more active than hydrogen, and so will displace this gas from such acids as sulphuric and hydrochloric. Metals below



Relative activity of the common metals may be determined roughly by the rate at which they liberate hydrogen from acids. Here, pieces of four metals are placed in dilute hydrochloric acid. Magnesium releases bubbles of hydrogen violently, zinc less rapidly, and iron rather slowly. Copper, located below hydrogen in the activity series, does not release it at all.

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hydrogen cannot displace it from any of the acids.

To impress this on your mind, you can make a visual demonstration. Add one part of hydrochloric acid to four parts of water and pour an equal amount of the diluted acid into each of four test tubes. Into one tube drop a piece of freshly polished copper, into the next a similar piece of iron, into the third a piece of zinc, and into the last a bit of magnesium. The magnesium reacts so strongly that the acid literally boils. Zinc releases bubbles a little less rapidly, iron displaces the gas rather slowly, copper not at all.

Another principle to be learned from the activity series is this: When any metal is placed in a salt of a metal that stands below it, the first metal is dissolved and the second is thrown out of solution. You can prove this in one instance by means of a color change. Dissolve some copper sulphate in water, and the copper ion will color the solution blue. Now add a little zinc dust and stir the solution thoroughly. If enough zinc has been added, the blue color will disappear. The zinc ousts the copper from the copper sulphate and joins with the sulphate radical to form zinc sulphate—which, in solution, is colorless. Red metallic copper also settles to the bottom of the beaker.

ACTIVITY SERIES

Metal	Chemical symbol	
Potassium	K	More active than hydrogen.
Sodium	Na	
Calcium	Ca	
Magnesium	Mg	
Aluminum	Al	
Zinc	Zn	
Chromium	Cr	
Iron	Fe	
Nickel	Ni	
Tin	Sn	
Lead	Pb	
Hydrogen	H	Acting much like a metal in displacement reactions, this gas is included as a guidepost.
Copper	Cu	Less active than hydrogen.
Mercury	Hg	
Silver	Ag	
Platinum	Pt	
Gold	Au	

Immersion plating of one metal on another is accomplished by this changing of places of metals. Iron, for example, can be given a thin plating of copper by immersing it in a solution of 7 grams of copper sulphate and

If a metal is placed in a solution of a salt of a metal below it in the series, the first dissolves, the other is thrown from solution. Add zinc dust to a copper sulphate solution and stir. The blue solution soon clears and red metallic copper is precipitated. The zinc ousts copper from the sulphate and joins with the sulphate radical, forming zinc sulphate.

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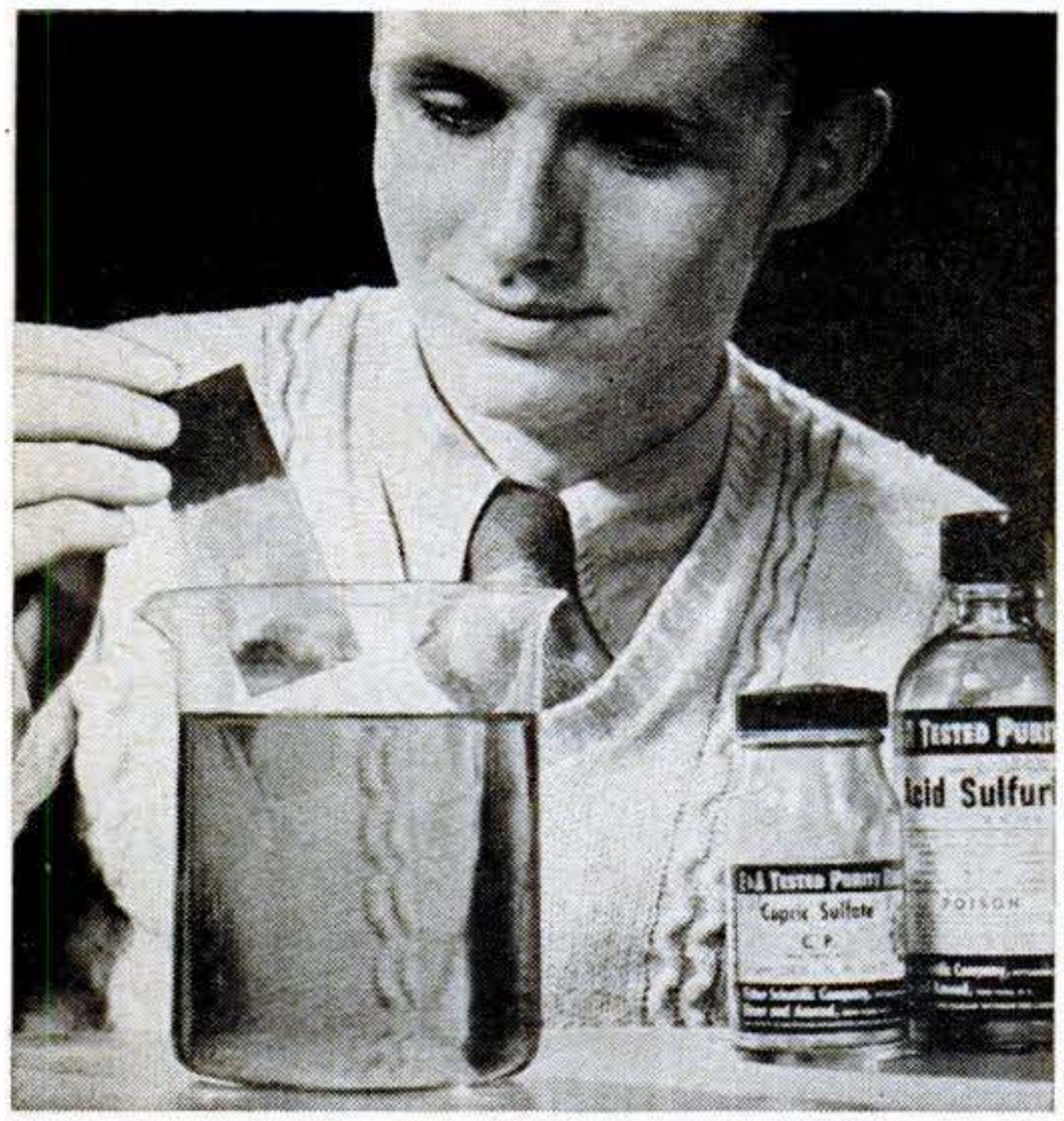
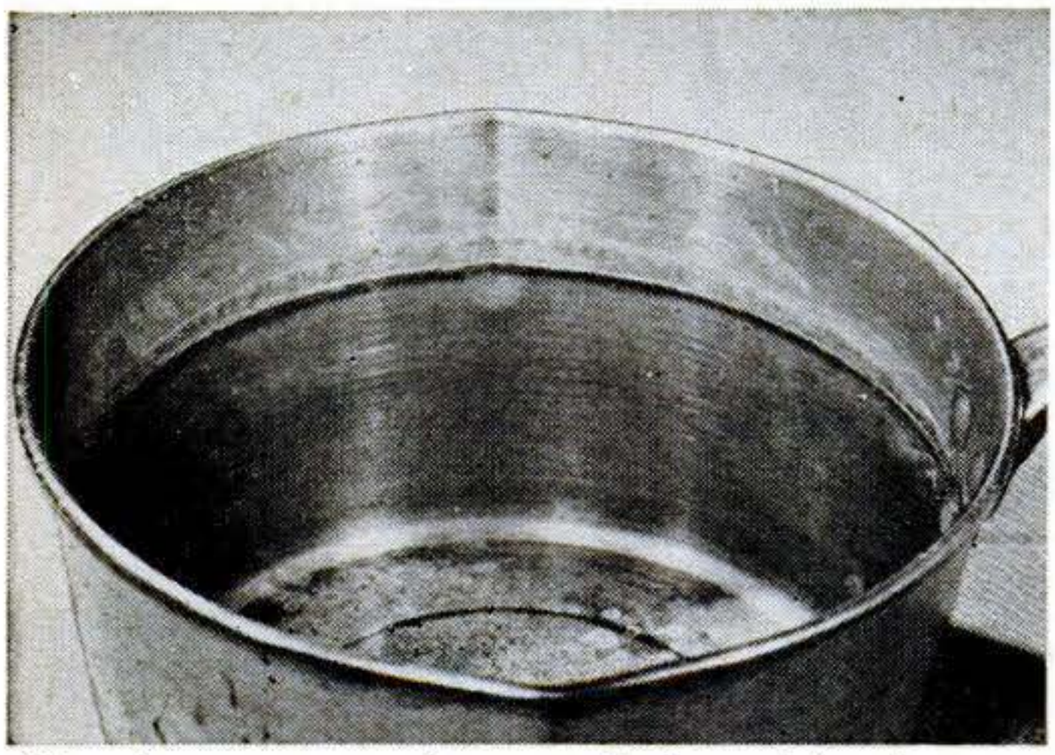


Immersion plating of one metal on another is possible because the metals change place. If iron is put in a solution of copper sulphate and sulphuric acid, copper will be deposited.

3.5 ml. of sulphuric acid in 500 ml. of water. A little iron changes place with some of the copper in the copper sulphate, and the displaced copper adheres to the iron. Only a light plating can be applied by this method. Prolonged immersion produces a spongy deposit that falls off.

Aluminum pots and pans in the kitchen are often darkened by the swapping of metals. If you cook oatmeal, spinach, or other iron-containing food in an aluminum pot, some of the aluminum changes places with some of the iron, the latter being deposited as a dark coating inside the pot. Although the neat housewife may scour away this deposit, she needn't do so, for the iron will be removed chemically if some acid food such as tomatoes, rhubarb, or sauerkraut is later cooked in the pot. The iron thus regained is harmless and a valuable food mineral.



Aluminum pans often are darkened by deposits of iron from certain foods, the iron replacing some of the aluminum. The iron may be removed harmlessly by cooking acid foods.

A more specific way to express the activity of metals is to say that they vary in ability to ionize, or give up electrons. Metals at the top of the list give up electrons more easily than those at the bottom. This difference makes electric batteries possible and explains corrosion and electrolytic action between touching metals.

If two metals of different activity are immersed in a suitable solution (electrolyte) and then connected by a wire, electrons will flow through the wire from the most active metal. The farther apart the metals in the series, the greater will be the electromotive force, or voltage.

A similar electrical effect accounts for the accelerated corrosion that often takes place when two metals are in contact in the presence of moisture. An electric current is set up, causing the more active metal to dissolve more rapidly than normal, while at the same time the less active metal is preserved from corrosion.

You can demonstrate this. Wind a short length of iron wire tightly around a piece of zinc, a similar wire around a piece of tin foil, and immerse these metal combinations in separate glasses containing dilute sulphuric acid (2 drops to 100 ml. water) with enough potassium ferricyanide to color the solution pale orange.

Quickly, the solution in the glass containing the foil-iron begins to turn blue, indicating that iron is dissolving and uniting with the ferricyanide. The other solution turns only faintly blue, if at all, for the zinc, being more active than iron, dissolves in place of it. This explains why the iron in "tin cans" corrodes more rapidly when the tin plating is broken than if it were not plated at all. It also explains why the iron in zinc-plated, or "galvanized" iron, is protected when the zinc coating is damaged. In the latter case, the zinc—being more active than the iron—dissolves, and in doing so forms a protective coating over the iron.

Solutions and "magic" plates or containers of aluminum that are sold to clean silverware without scouring depend upon an exchange of metals. Ordinary baking soda (sodium bicarbonate) and salt (sodium chloride), plus any aluminum pan, will

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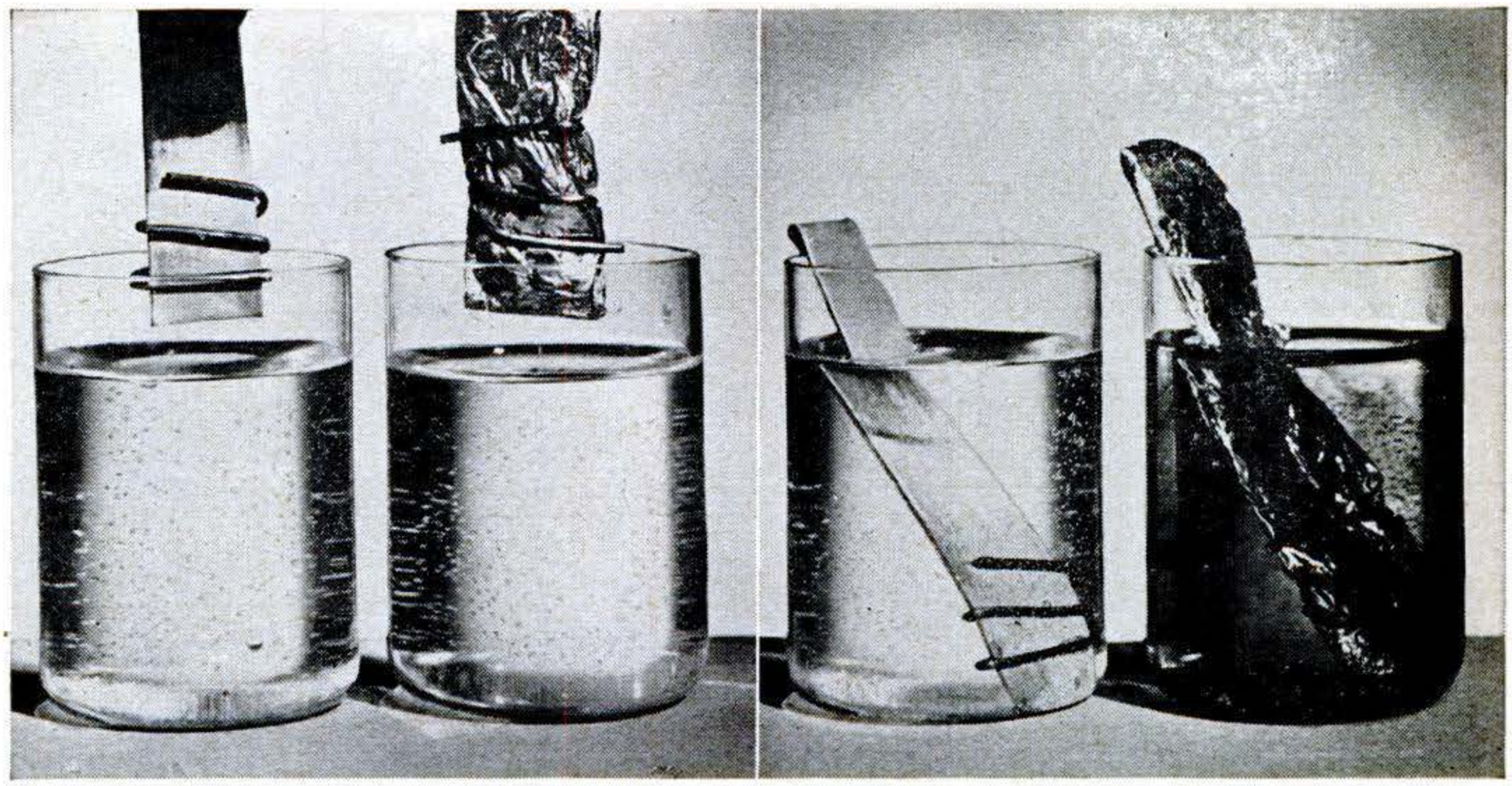
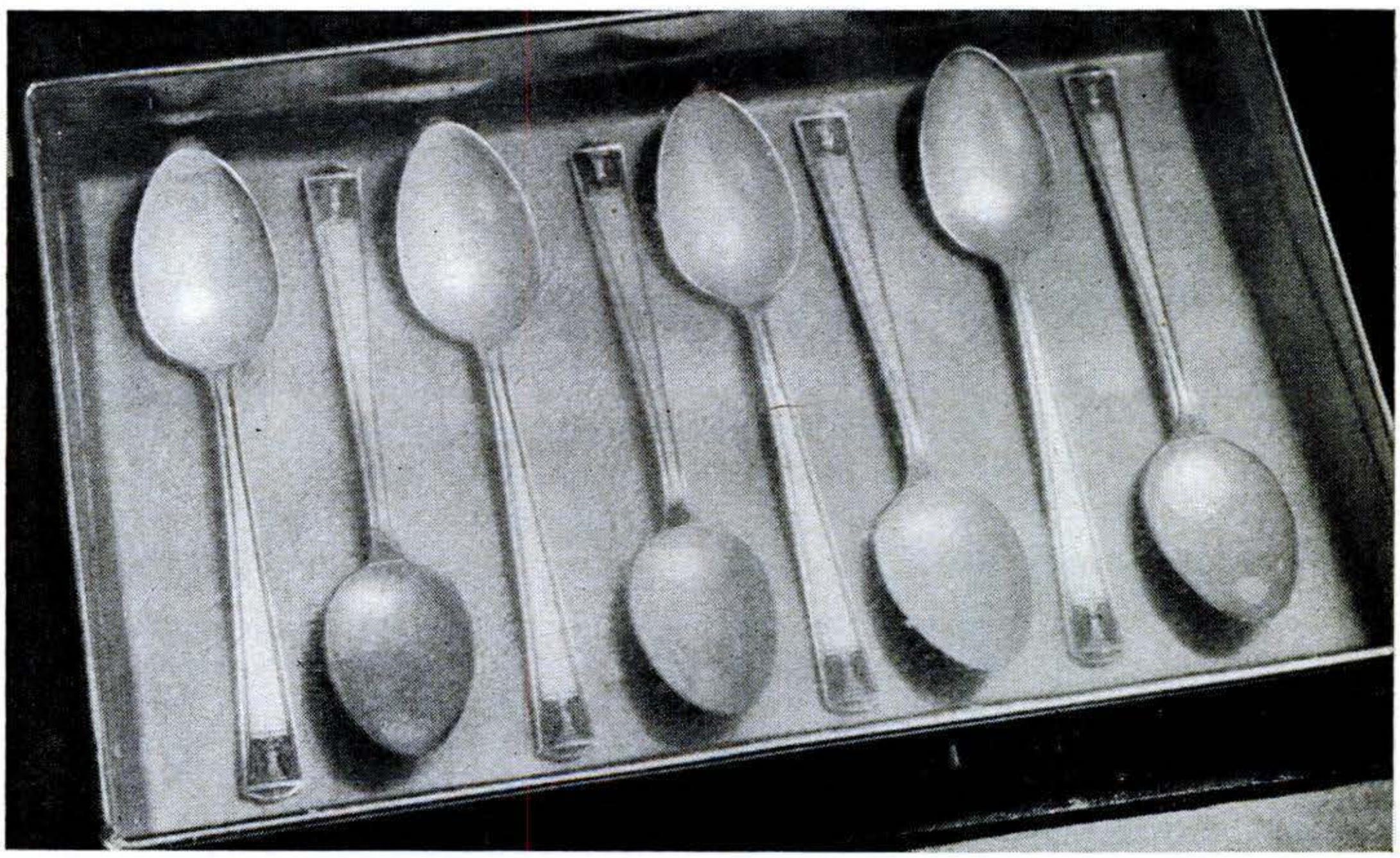


When two metals of different activity are in contact with each other in an electrolyte, an electric current is set up, causing the more active to go into solution more rapidly than it normally would. This may be demonstrated by winding iron wire around zinc and tin foil and then immersing each combination in dilute sulphuric acid and potassium ferricyanide.

enable you to work the same magic. Place the silver so that each piece touches the pan. Cover with a hot solution of 1 teaspoonful of soda and another of salt to each quart of water. After several minutes, remove the silver, rinse, and polish with a soft cloth.

Touching the aluminum and surrounded by the electrolyte, the silver forms one plate of an electric cell. By action of this cell, the tarnish of silver sulphide is dissolved. Then the sulphur is ousted and the silver is redeposited. The method should not be used on "French finish" silver, for it may alter the finish as well as clean the surface. END



If silver is covered with a hot solution of salt and baking soda in an aluminum pan, an electrolytic action takes place. This cleans off the tarnish without removing any of the silver.

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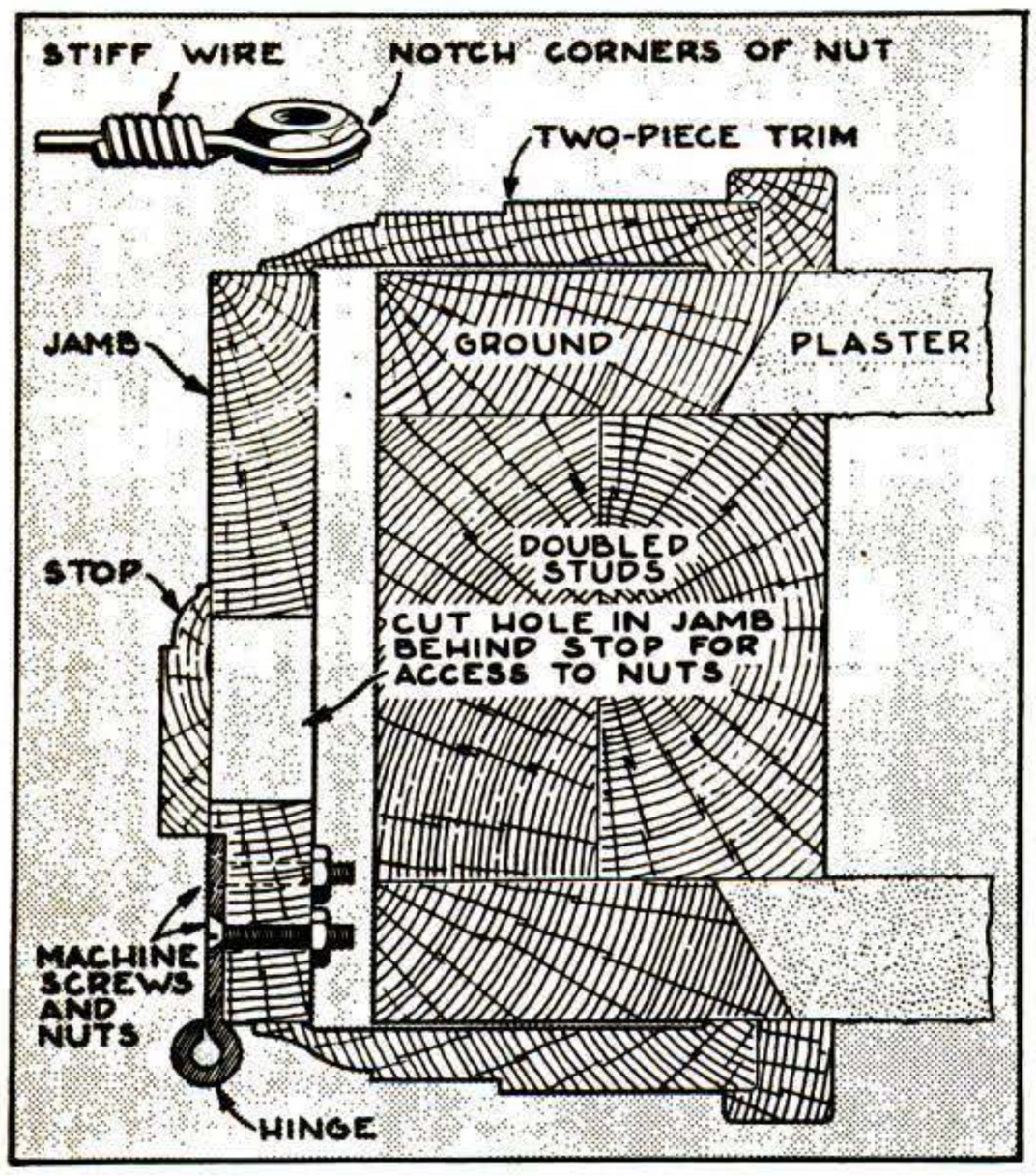
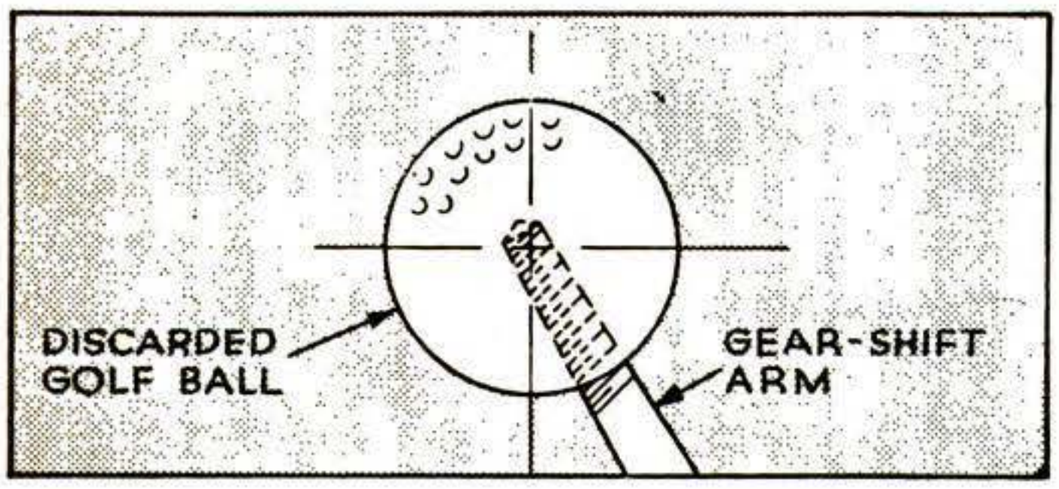


Stove Bolts Hold Loose Hinges

When the screws holding door hinges to the jamb lose their grip on the wood, try replacing them with stove bolts. Remove the stop strip and bore several large holes—of a size that will be concealed when the stop strip is replaced—to gain access to the back of the jamb. Then drill through the old wood-screw holes to permit insertion of flathead machine screws. To aid in starting the nuts on the screws, it may prove useful to file small notches in the corners of each nut, wrap stiff wire around it, and maneuver it through the access hole with the end of the wire until the nut is engaged on its screw.—John E. Baker.



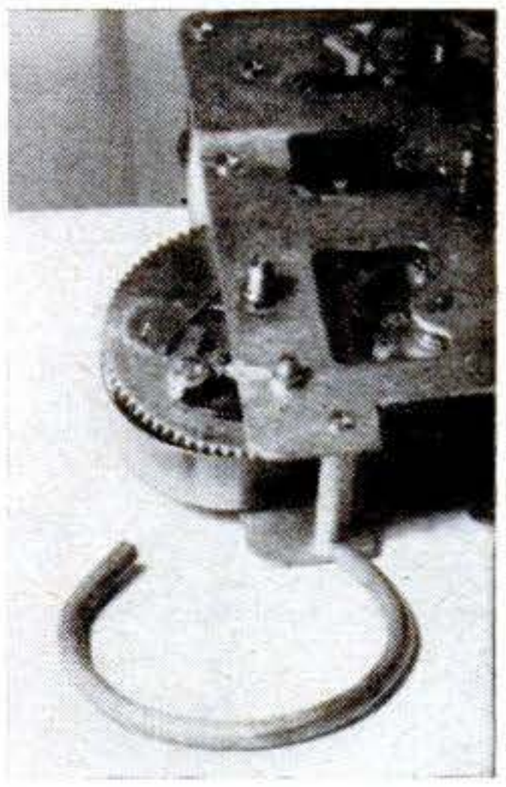
Golf Ball Becomes Shift Lever

If you have a floor-type gearshift lever on your car, a golf ball will make an unusual knob. Measure the root diameter of the thread on the lever, drill a hole of this size about ¾" deep, and then screw the ball onto the shaft. The threads on the shaft will cut their way into the rubber cord inside of the ball.—E. M. Rolnick.

Can Makes Alcohol Blowtorch

The hot needle flame of an alcohol blowpipe is handy for hard and soft soldering, tempering small steel parts, annealing clock springs, and other chores. An old oil can makes a good torch if fitted with a blowing nozzle, tube, and mouthpiece as shown above. After cutting the spout short, solder on an S-shaped piece of copper tubing, its end pinched to a narrow slit. A cigarette holder on the tube makes it more comfortable to hold in the mouth. If the cap makes an airtight fit, punch a tiny vent hole in it so the alcohol will feed freely. A tin-foil cap twisted around the asbestos wick helps prevent fuel evaporation when the torch is not in use.—J. A. Richards.

Stiff Wire Holds Clock Spring



When disassembling a clock in which the main spring is not contained within a barrel, for convenience in handling clamp the spring in a clip bent from heavy baling wire or a large nail. Wind the clock up tight and fit the clip closely, bending it tightly around the spring with light hammer taps. Then disengage the pallet to let the spring fill up the clamp. When it is at rest, the whole spring, wheel, and arbor may be removed as a unit. Use wire around the spring and pillar if no clip material is at hand, but in this case the spring must be left on the plate to which the pillar is attached.—William Schopp.

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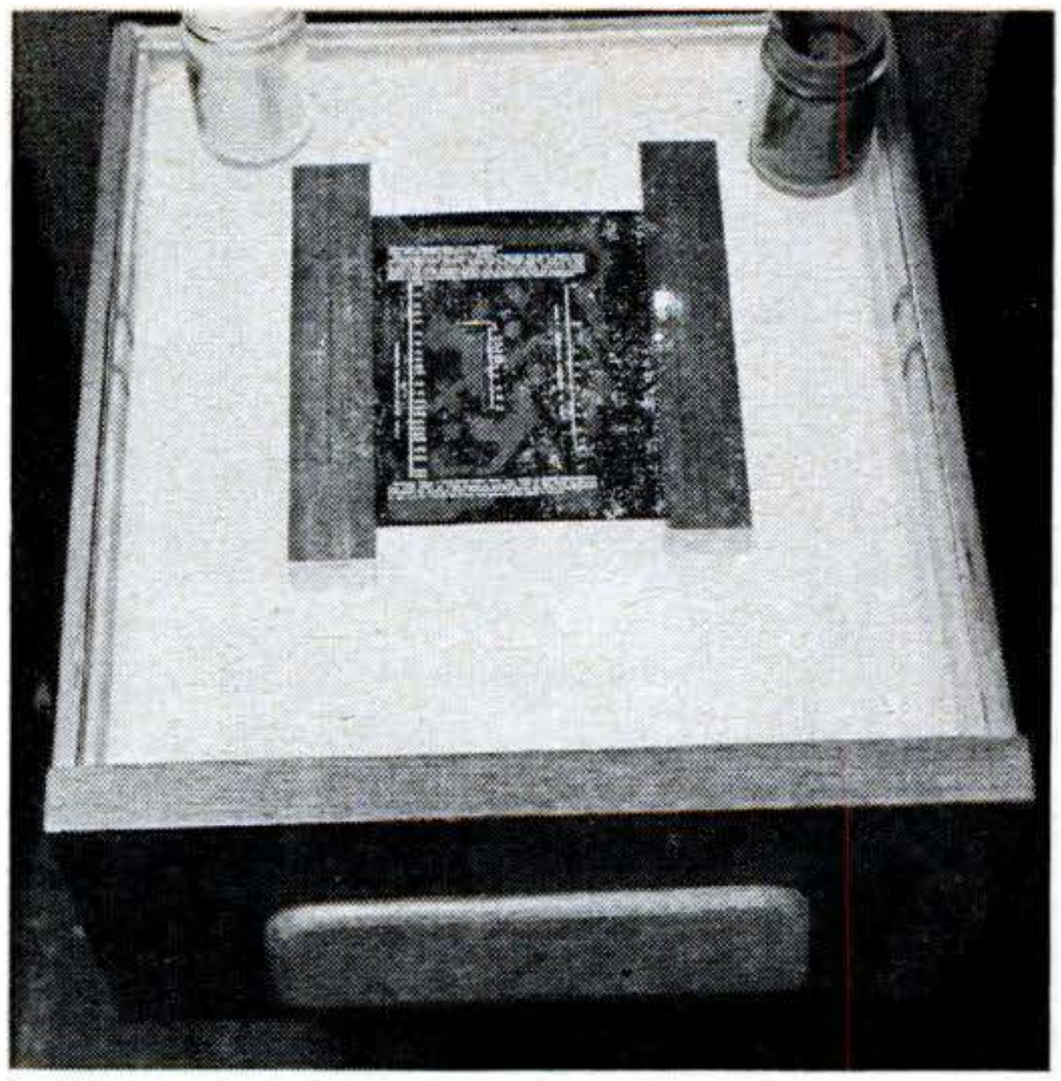
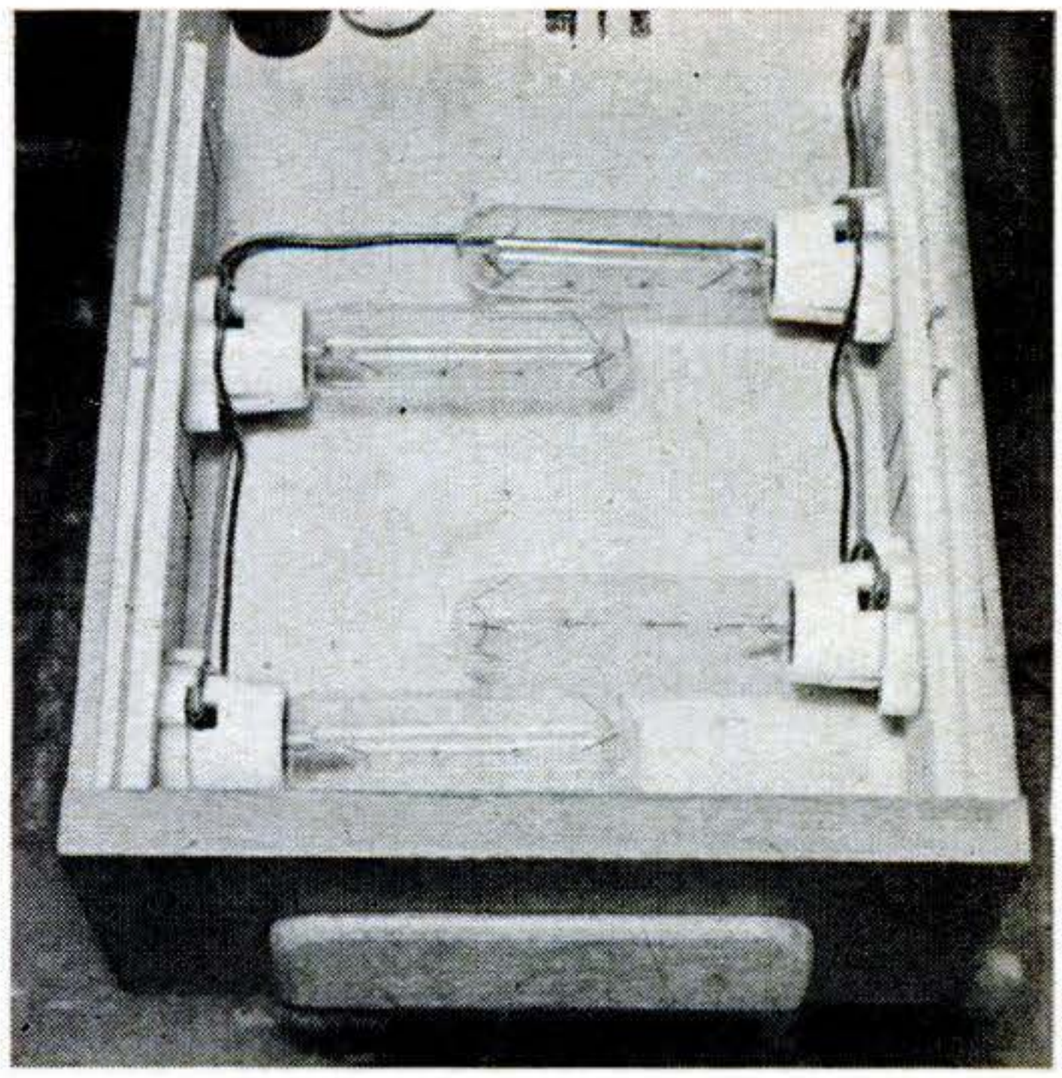


Lighted within, this glass-topped desk drawer serves as a handy viewer and retouching stand.

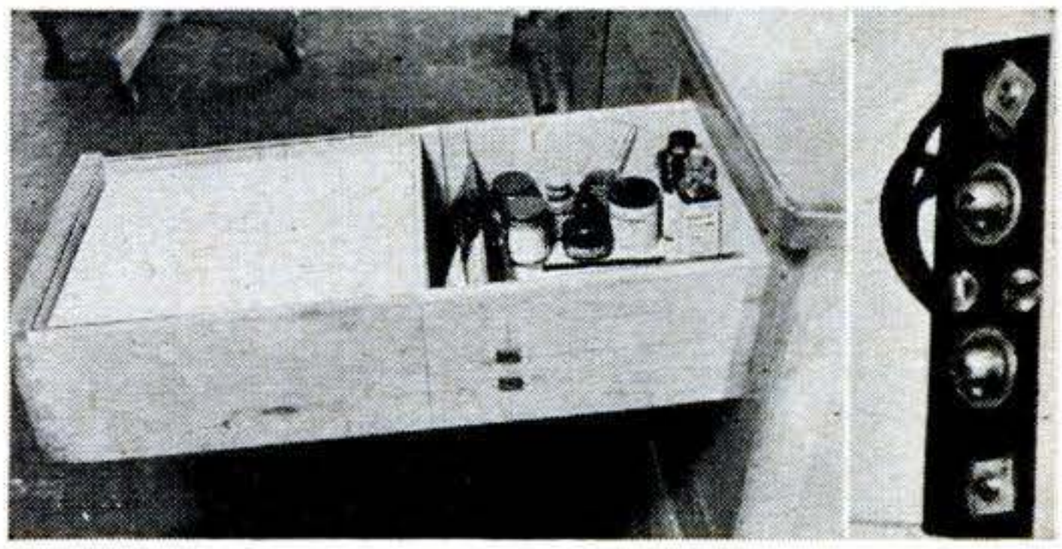


Tubular incandescents, wired in parallel, are employed. An opal-glass sheet diffuses the light.

Desk Drawer Is Negative Viewer

An ILLUMINATED desk drawer is a real convenience for any desk worker who has occasion to inspect or retouch photographic negatives. It eliminates the need for a separate viewing and opaquing stand, is easily accessible, and slides neatly out of sight when it is not needed. The materials used in making the unit aren't expensive, and no permanent harm is done to the desk.

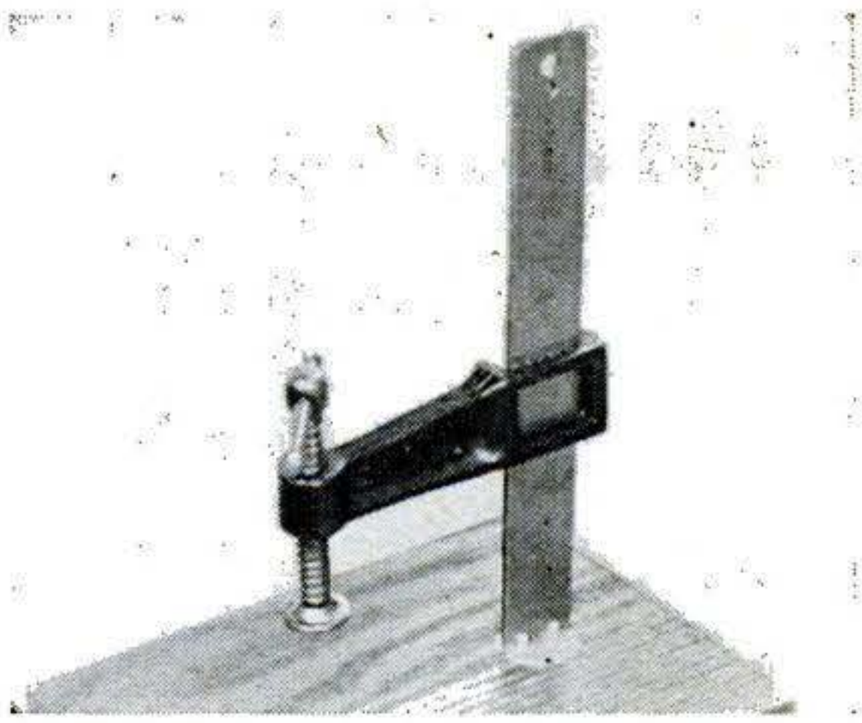
Recessed to lie flush with the upper drawer edge, a piece of ¼″ plate glass forms the working surface. About ¾″ below it and supported on two cleats, a sheet of ⅛″ flashed opal glass diffuses the light from four 25-watt tubular incandescent lamps. Current for them is provided through a pair of brass contacts on one side of the drawer that bear against a pair of bullet-type cupboard catches on an insulating mount within the desk frame. These contacts also serve as a switch, automatically turning on the lights when the drawer is in working position. Materials for retouching negatives are stored behind a partition at the back of the drawer.—G. Dexter Herndon.



Brass contacts, visible on the extended drawer above, lead in the current. They bear against two insulated cabinet catches shown at right.

Broken Speed Clamp Converted to Bench Clamp

Under pressure a common kind of quick-adjusting clamp sometimes breaks at the point where its fixed cast-iron head is attached to the steel slide bar. The intact portion may be converted to a small but useful bench clamp by mounting it in a block of wood. This should preferably be maple or oak, about 2″ by 5″ by 7″. In it bore a 1″ hole about 1½″ deep, locating it 1″ from the edge of the block. Drive the slide bar into the hole and check to make sure it is exactly at 90 deg. to the surface of the block. Then anchor it in place by pouring melted lead or Wood's metal on both sides of the slide bar.



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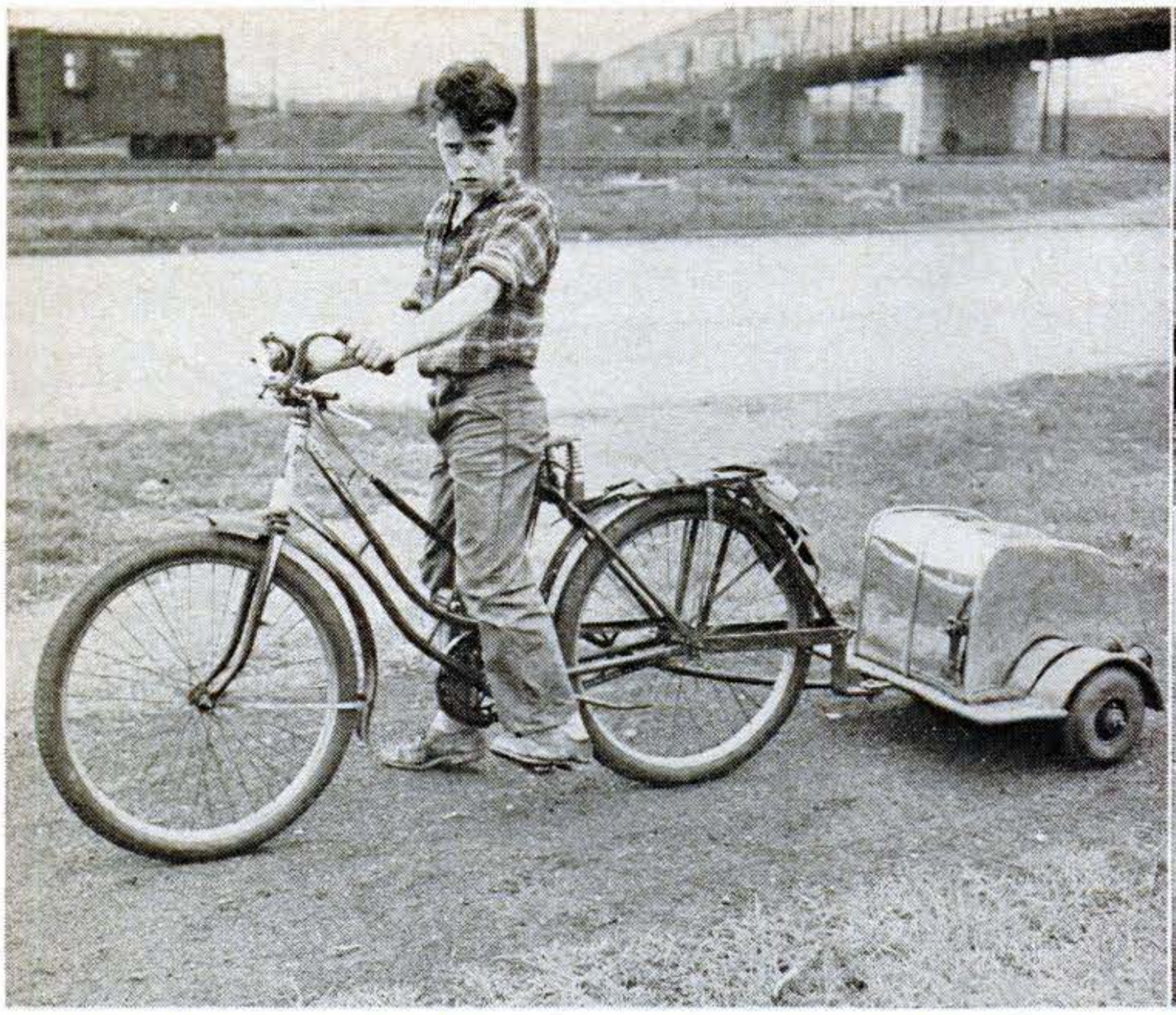


Pushing a bike is just one of the jobs this versatile unit can do. Flexible cables bring the controls within easy reach of the rider. At upper right, the unit is rigged as a power lawn mower; used as a motor scooter (lower right) it betters 25 m.p.h. on the highway.

Motor Unit Runs Bike or Mower

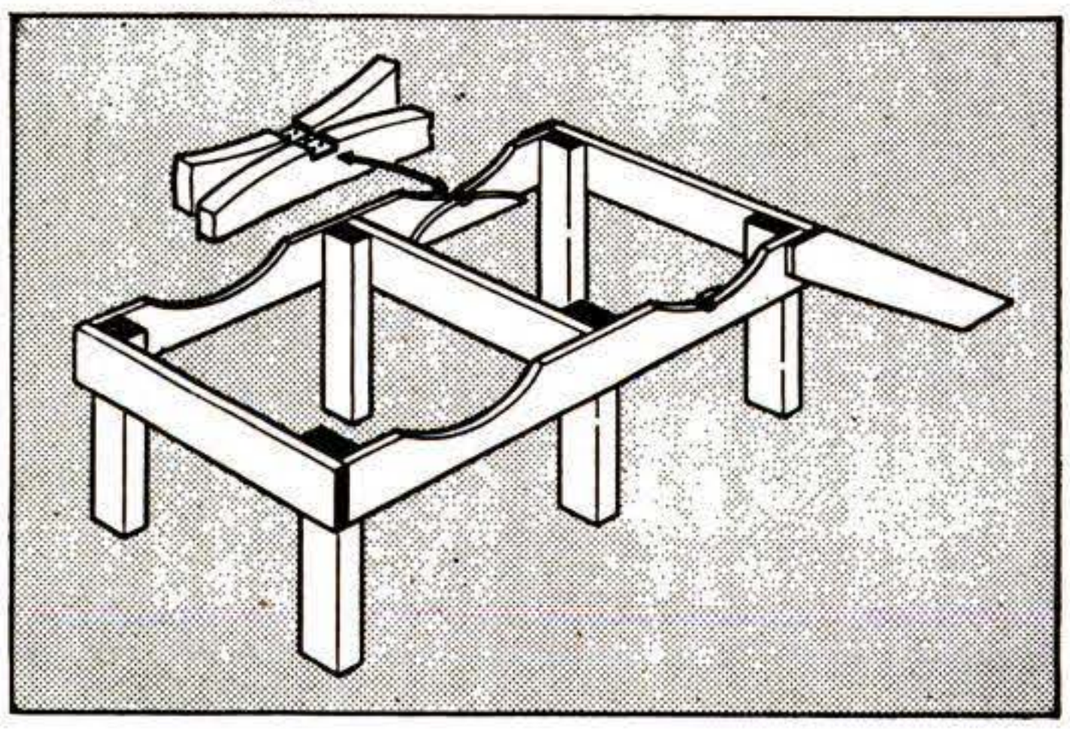
POWERED by a 1½-hp. engine, a two-wheeled unit designed and built by William Lusk of Cicero, Ill., can be readily attached to a bicycle, lawn mower, or scooter. Small pneumatic wheels carry its 200-lb. weight without marking soft turf and give ample traction for cutting heavy grass. Used on the highway as a scooter or bike motor, the unit delivers better than 25 m.p.h.

Lusk used a ⅛″ steel plate as a combined platform and chassis. The axle is a ⅝″ steel shaft running in ball bearings, with a small over-riding clutch at each wheel to give differential action. Power is transmitted by a pair of V-belts from the engine to a 7-to-1 gearbox taken from a washing machine. A movable idler acts as the main clutch. By using V-belt pulleys of different diameters, Lusk changes the effective gear ratio to suit the job the unit is doing.

For looks and safety, the engine is housed in an aluminum covering. Sheet-metal fenders cover the wheels, and slit garden hose on the fenders and base acts as a bumper. The clutch and throttle controls are led to the handle bars through a flexible conduit.

Hinged Cut-Outs Aid in Loading Oil-Drum Rack

IF YOU build a rack to hold several oil drums, save the cut-out portions of the stringers and mount them as shown at the right, using small butt hinges. Mortise the hinges sufficiently so that the drums will clear them on the rack. When you want to move a heavy drum on or off the rack, flip over the cut-outs so that there will be a level track to roll it on. The stunt, which is especially helpful with long racks, can be applied to racks already built by making new cut-outs—W. VAN SANDT.



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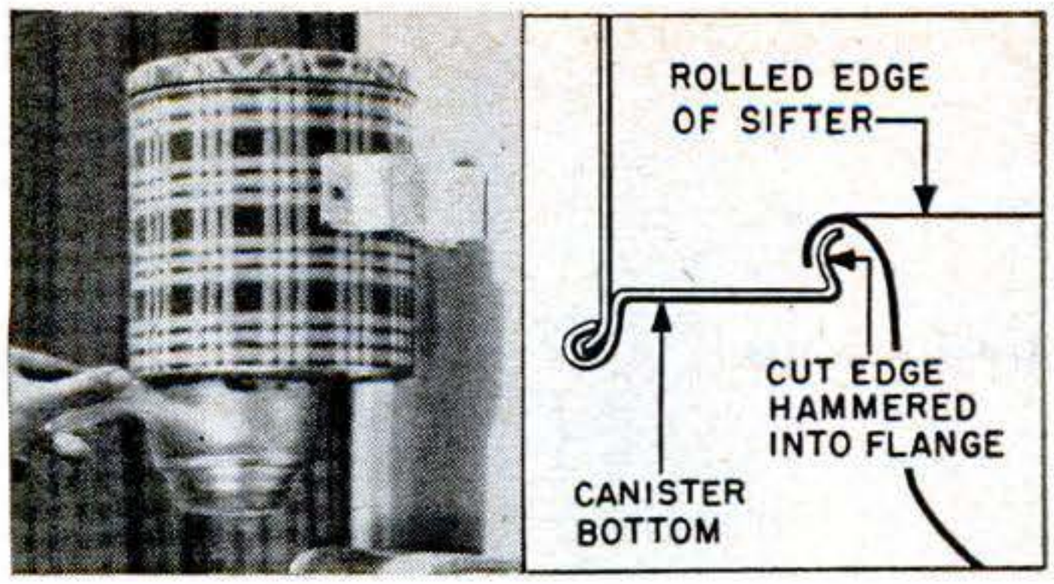
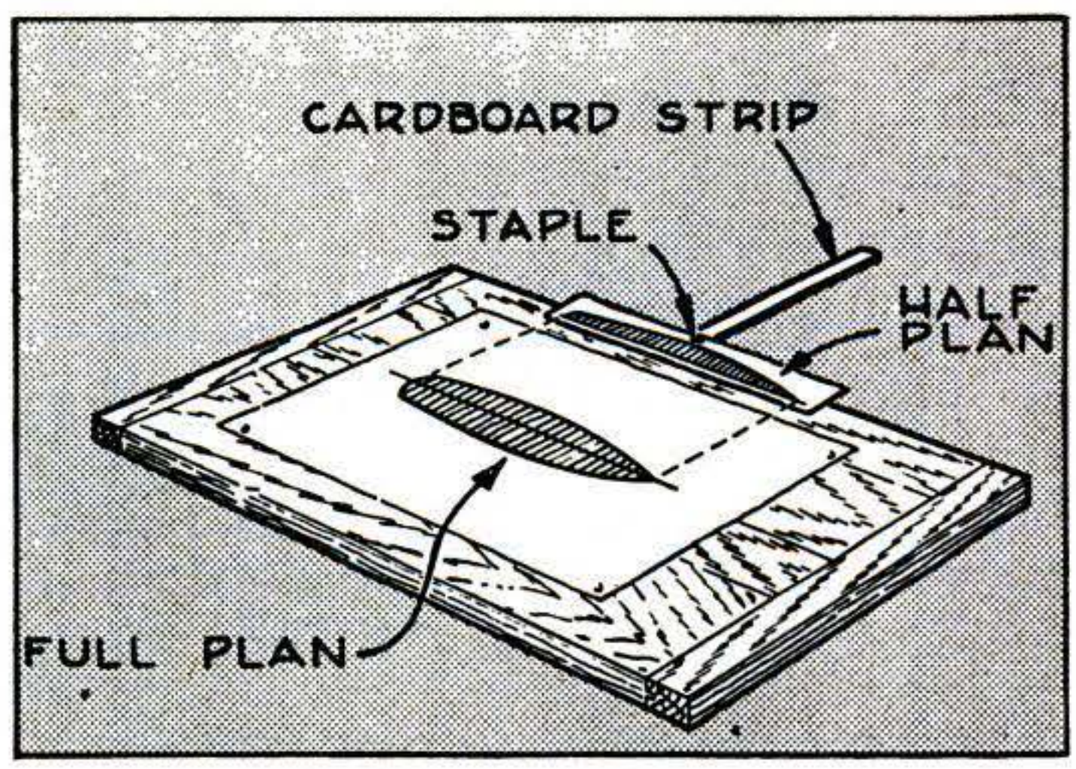


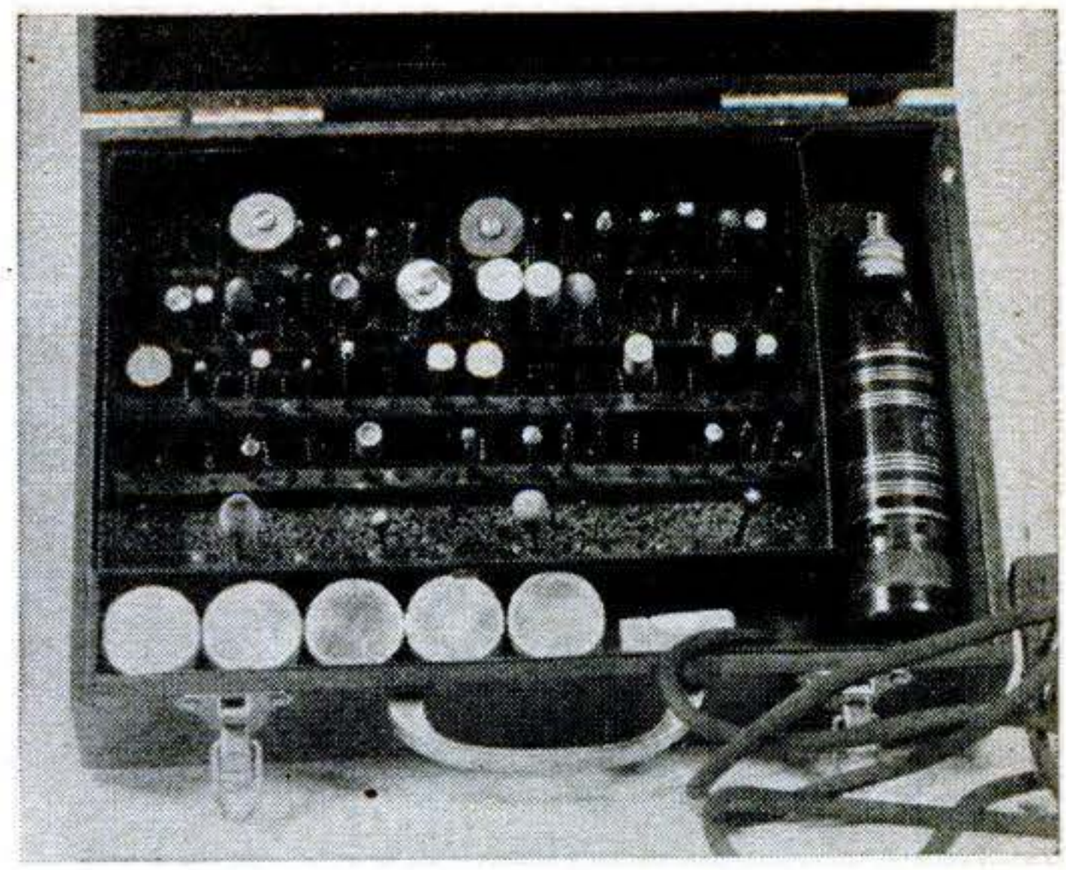
Sifter Attached to Flour Can

If you've ever watched a woman get a measured cup of sifted flour, you've probably yearned to streamline the process. She puts the flour in a bowl, sifts it into a second one, measures a cup, and then tries to get the surplus back into the flour bag. By attaching a sifter to the bottom of a wall-mounted flour canister, I've made the process much simpler. I cut a hole in the canister bottom that was a bit smaller than the sifter top, and hammered the cut edge upward so that the sifter edge rests on it. Either a wood or metal bracket may be used to attach the canister to a convenient cupboard wall.—Russell McCandless.



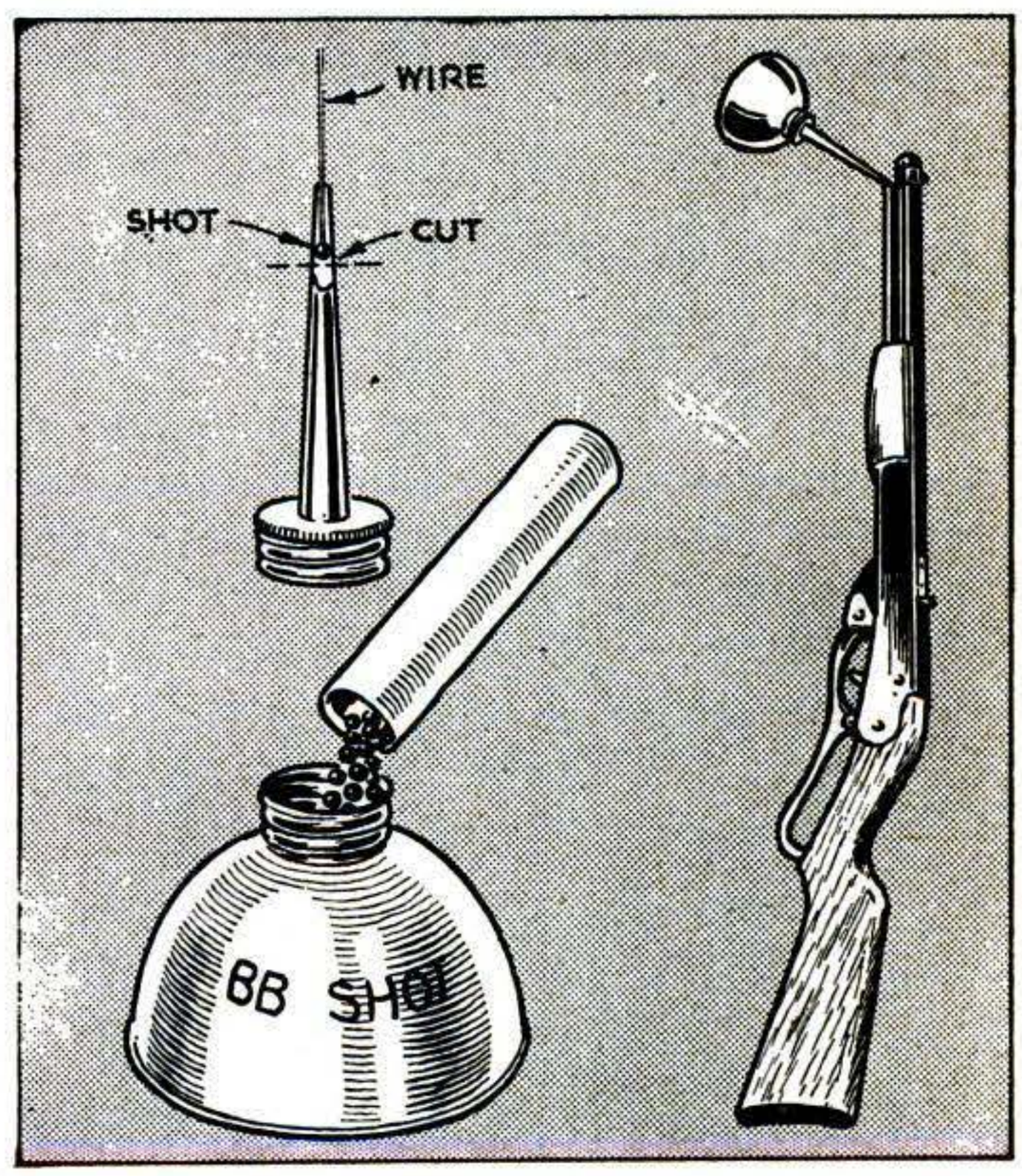
Drawing Symmetrical Objects

When you have to draw a symmetrical outline having irregular curves, such as the deck plan of a boat or a wood-turning profile, first draw the half plan carefully on a piece of tracing paper. Staple this to a strip of cardboard for easy handling. Fasten tracing paper to the drawing board and with the strip maneuver the half plan into position underneath. Trace it off; then withdraw the half plan, turn it over, and insert it from the other side. Aligning it carefully with the center line, trace the second half. The stunt is also useful where a part must be redrawn several times in various positions.—John G. Kingdon.



V-Belt Strips Hold Tool Bits

The more cutters and wheels I got for my hand grinder, the harder they seemed to keep in order. Finally I cut an old V-belt into 7″ lengths, drilled ⅛″ holes in them ¾″ apart, and nailed them to the box bottom. The same holes take all three of the common shank sizes.—T. Walley Williams.



Air Rifle Loaded with Oil Can

For a handy, nonspill loader for air rifles, obtain an oil can and cut off the tapered spout where it has an inside diameter slightly larger than a single BB pellet. To locate this spot, lodge a BB in the uncut spout, measure its position with a wire, and then hacksaw through the spout a trifle below the position where it lodged. Clean off the sawing burr and label the can to prevent possible mixups.—Kenneth Sidel.

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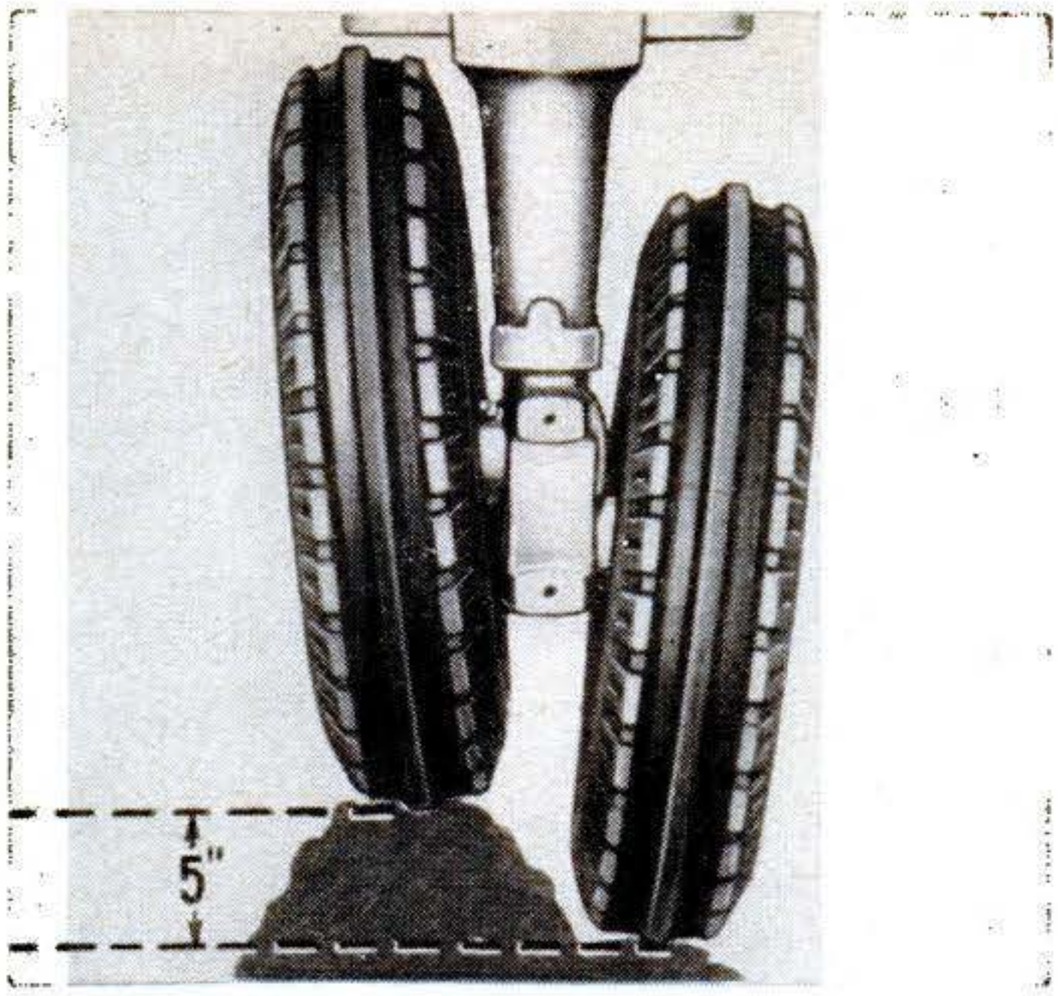
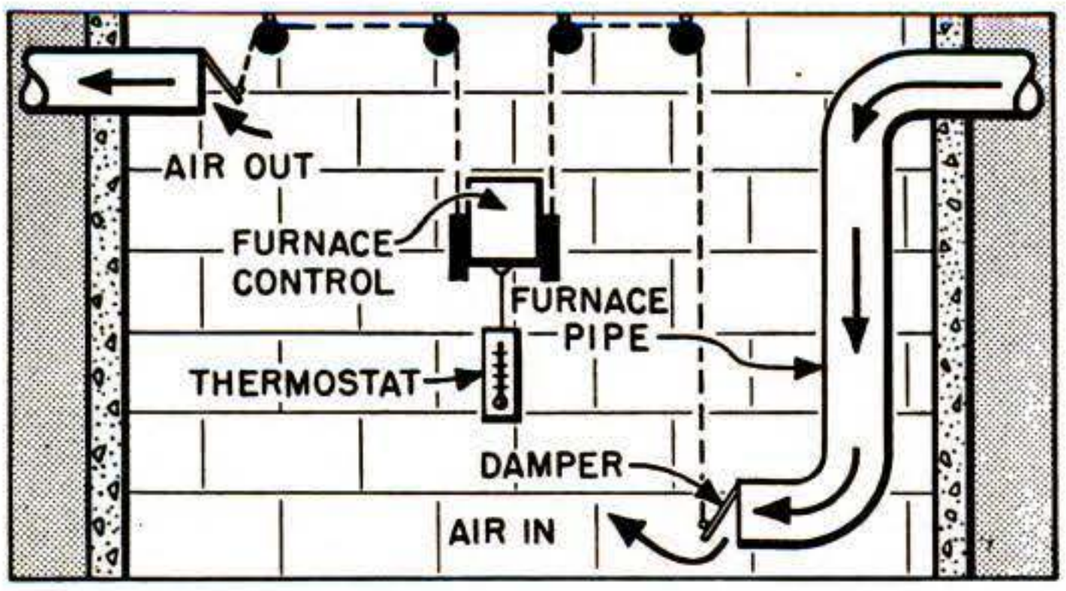
FOR EASIER FARMING

Tractor Engine Is Air-Cooled. Weighing only 750 lb. and easily transported on a truck, this utility tractor has individual rear-wheel brakes, pivoted front-wheel suspension, and three speeds forward and one in reverse. It is equipped with two power takeoffs. Built by the Lincoln Tractor Co., Arcadia, Calif., it is powered by a 6-hp. air-cooled engine made by Salsbury Motors, Inc., Pomona, Calif.

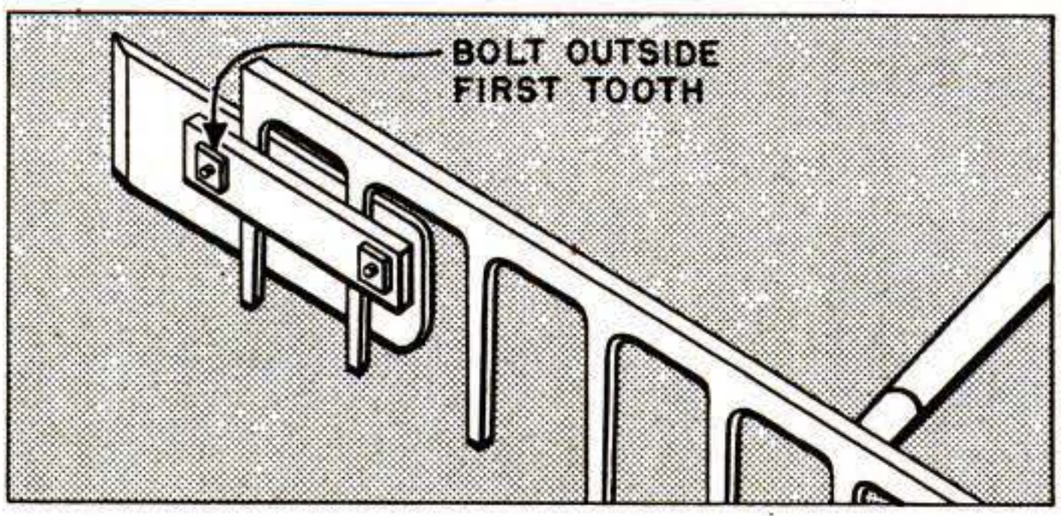


Wheels Equalize Load. By means of a type of knee action, each front wheel on new tractors made by John Deere, Moline, Ill., always bears an equal share of the load. Any up or down movement of either wheel is transferred through gears to the other so one falls the same distance the other rises. Thus, if one rides up on a rock 5″ high, the other is forced down 2½″, so that the tractor itself rises only 2½″ instead of 5″.

Vegetable Bin Kept Cool. I have found that a draft control from a furnace provides an excellent means of keeping my vegetable bin at the proper temperature. Stovepipe on one side of the bin admits air and carries it to the floor. Another pipe near the ceiling on the other side lets it out. With the thermostat set at the desired temperature, the dampers are closed or opened automatically as the need arises.—E. J. Mann.



Trip Rope Never Slack. A spring-tensioned trip rope produced by the Accessory Manufacturing Co., Gervais, Ore., takes up slack or pays out when the implement that is being drawn lifts, drops, or turns, and there is ample rope for stopping after the spring hitch releases. Easily mounted on any tractor, it sells for approximately $9.



Rake Chopper Is Handy. An old plane or scraper blade clamped to the end of a rake provides a useful weeding or cultivating tool. The blade may be attached with a flat strip of iron and two bolts that will pass through the slot in the blade. If a slot must be cut or lengthened, soften and reharden the blade.

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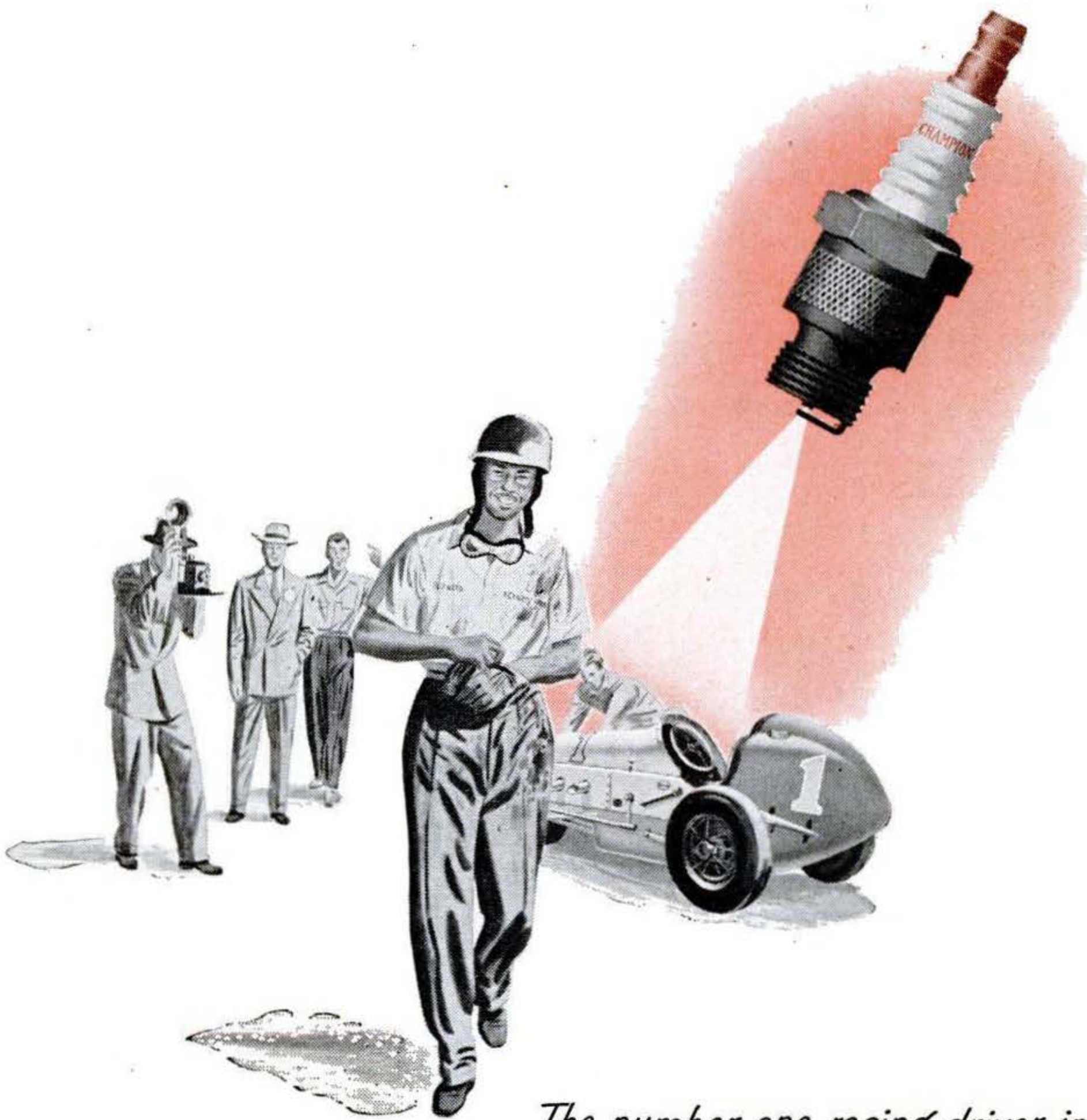
Dependable

CHAMPION

America's Favorite Spark Plug



The number one racing driver in 1947— as in 1946— used the number one spark plug of the nation to win both crowns. Both are true Champions— Ted Horn, national AAA champion, and Champion Spark Plugs.

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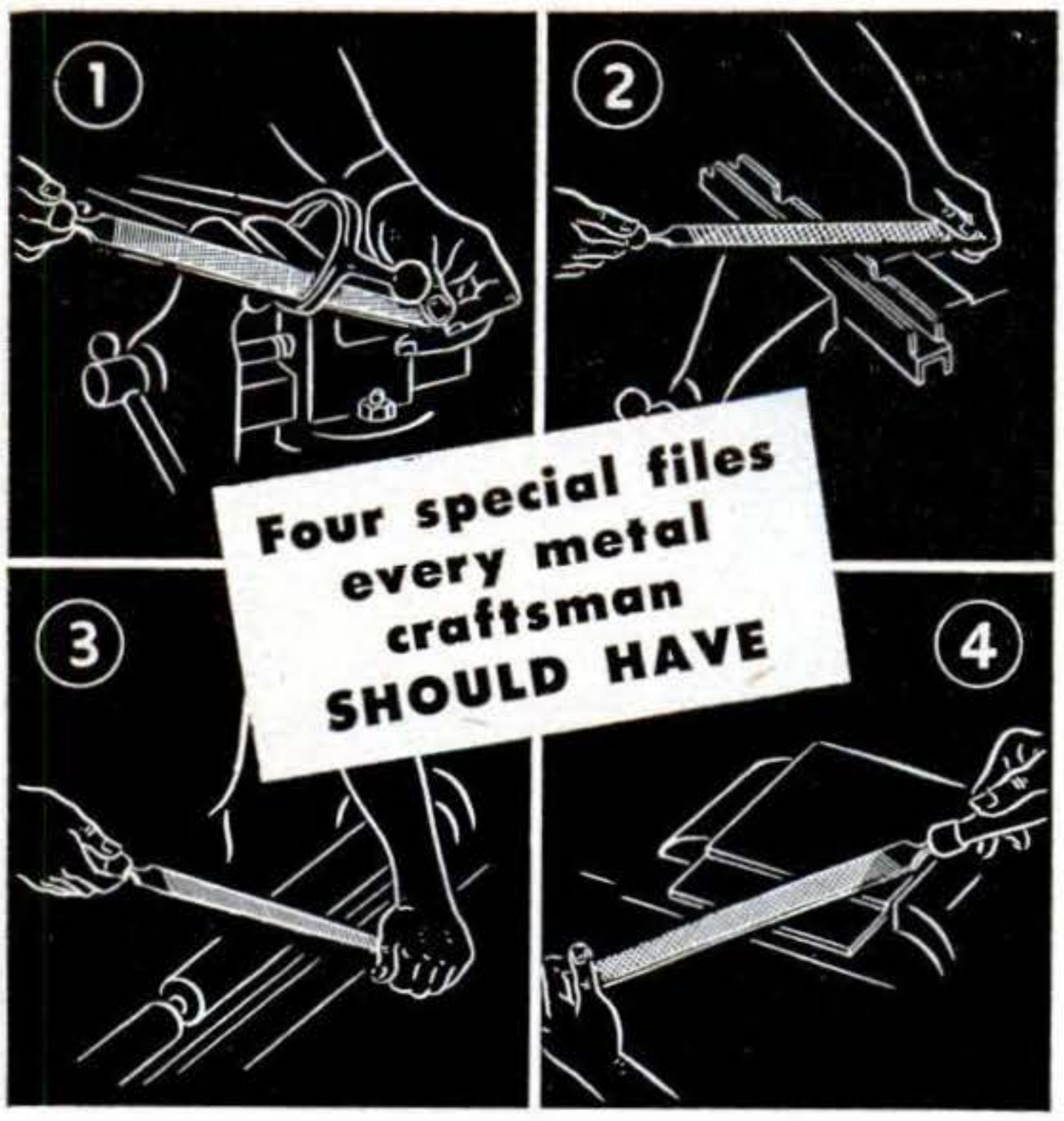

The use of *The right file for the job* gives craftsmen greater speed and assures better work. Nicholson has carefully designed special file cuts for use on different metals. Four of such files are shown here.

1. BRASS. For this soft, ductile metal you need this file with its long overcut and short upcut designed to break up the filings and clear out the chips.

2. ALUMINUM. This "Type A" file overcomes "chatter" and clogging tendency through "open-throat" upcut teeth and fine overcut.

3. LATHE FILING. Long-angle single cut gives this file clean-shearing, self-clearing qualities that enable you to do a fine smoothing job.

4. STAINLESS STEEL. Sturdy, specially sharpened teeth keep this file cutting better and longer under the abrasive action of the hard chromium and nickel content of dense, tough stainless steel.

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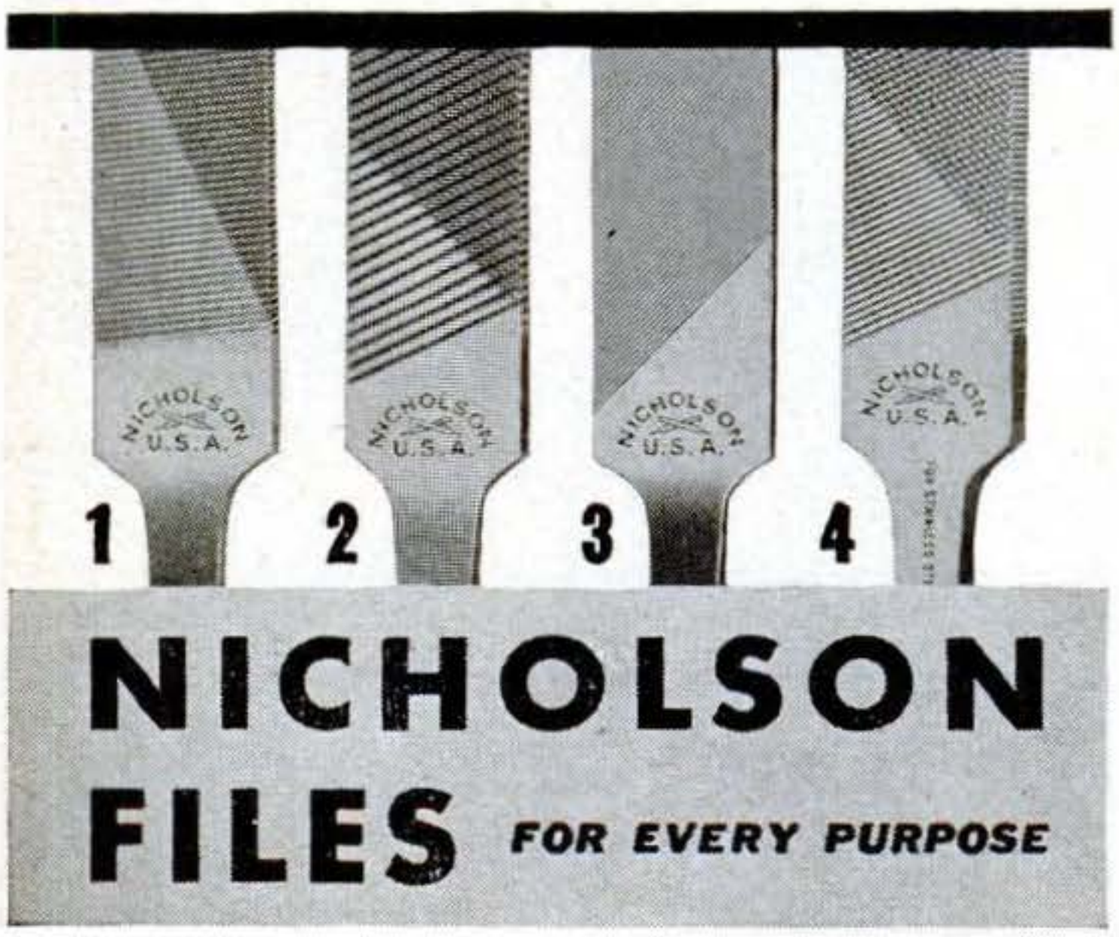

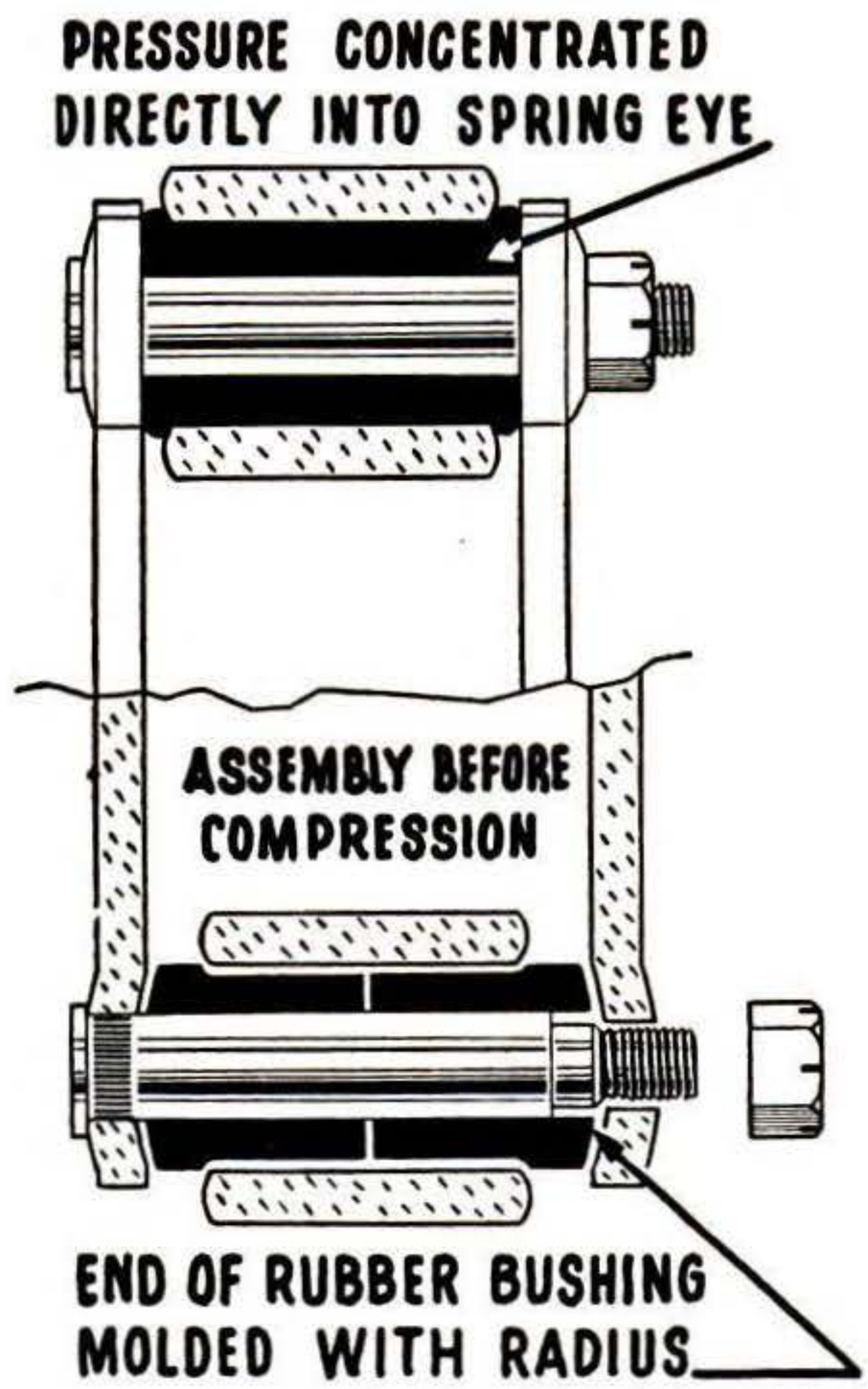

Sturdier Spring Shackle

A LIFE four to six times that of an ordinary automobile spring shackle is claimed for a new Harris concentrated pressure version. Schematic drawings, above, show how it works. Increased pressure at no higher cost is achieved by using a rubber bushing molded with a radius instead of a straight shoulder, as shown in bottom sketch, plus redesigned side plates to concentrate force directly into the spring eye, as illustrated at top. The manufacturer says that many 1948 cars will have this new feature.

Attachable View Finder

WITH a new eye-level view finder attached to top of Micro 16 camera, as shown at left, both vertical and horizontal pictures can be taken more efficiently than with the regular built-in finder. It is also helpful in holding the tiny camera steady. Easily slipped on, the device can be moved out of position so that it does not have to be taken off when camera is put back into its case.

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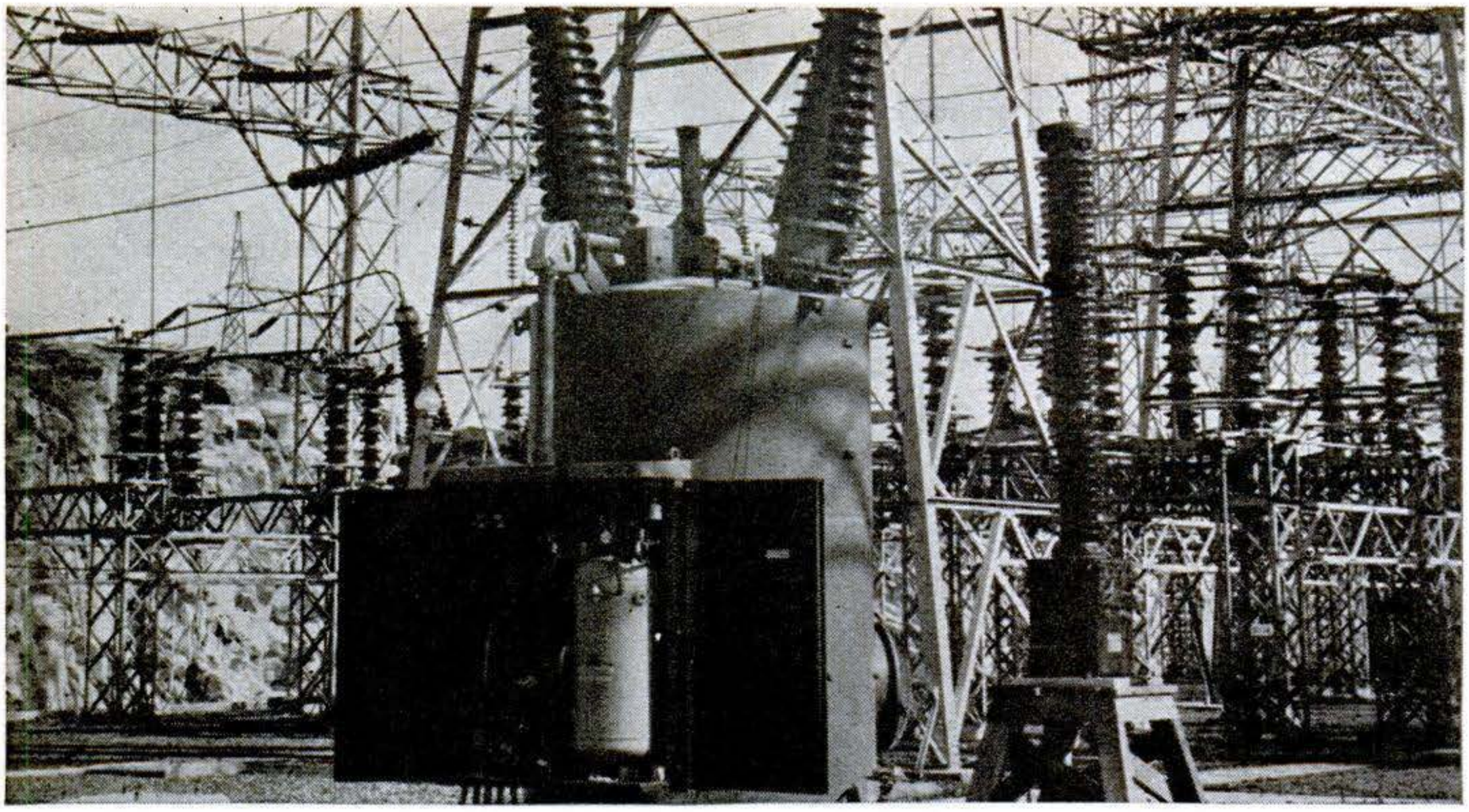
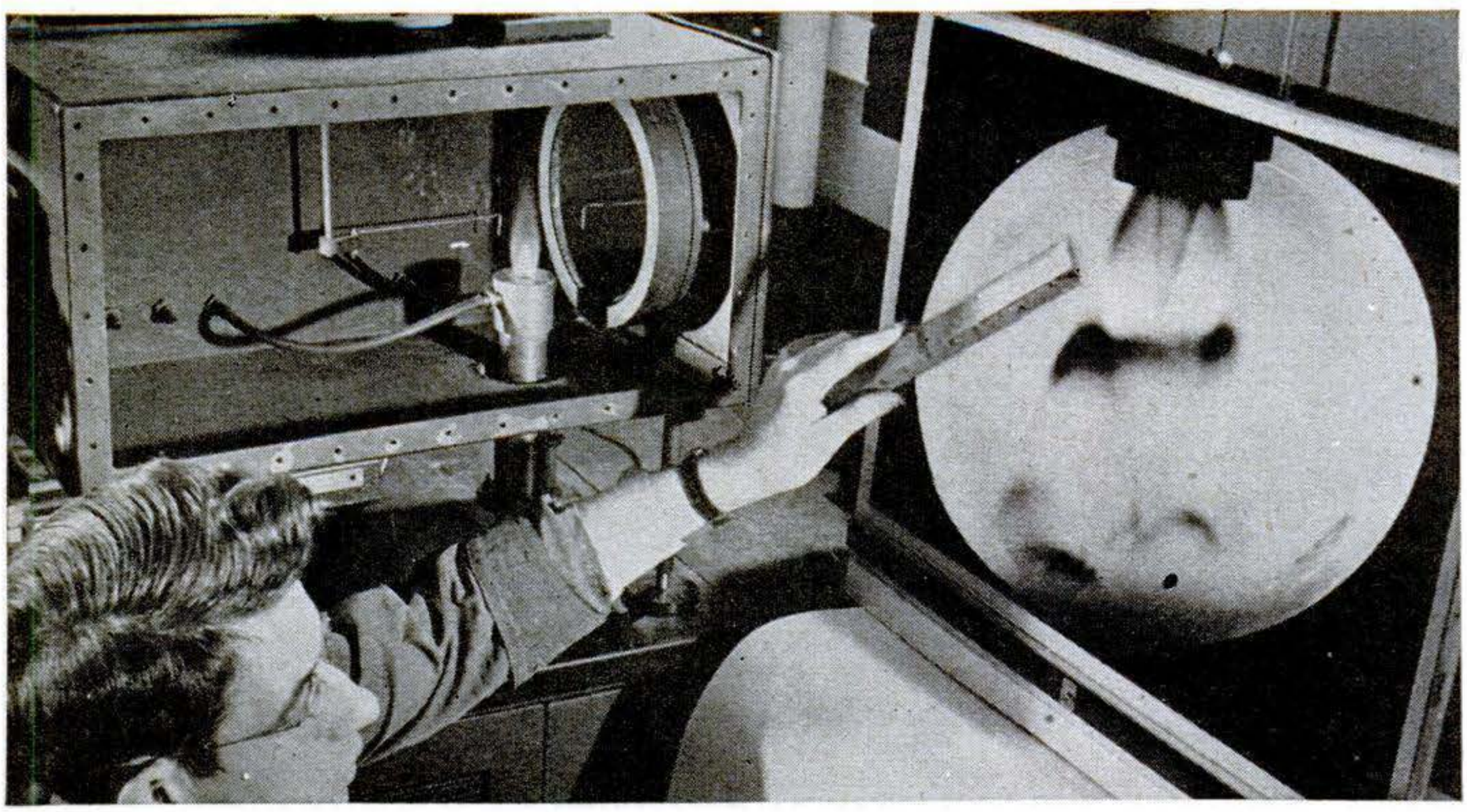


Oil Quenches Shorts

THIS two-horned giant is a new oil-operated circuit-breaker in use at Grand Coulee Dam. When a sudden surge of high voltage, such as a stroke of lightning, shorts the circuit, relays open the contacts but permit the current to arc across them, vaporizing the oil in its path and pushing it away. Automatically, a second arc pushes the oil back to smother the first, then dies out itself. In a recent test, the Westinghouse breaker cleared a short of 7,500,000 kilovolt-amperes in less than a second.



Flame Studies Aid Jets

FROM little flames grow giant jets, Westinghouse scientists believe. Through the study of candle-sized flames, they are working to improve the design of airplane jet engines. For ease of study, the tiny flames are reflected by a series of lenses and projected in magnified image upon a screen in front of an observer, as shown above. This enlarged image permits accurate measurements of the cone in the center of the flame. These measurements permit calculation of the speed at which the fuel is being converted into heat—an important factor in the efficiency of gas-turbine engines.

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AMAZING NEW SAFE MAGNETIC JIG SAW

READY for PROFIT and PLEASURE!

NUMBER 2000

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Craftsmen, Light Production
GREATEST CLEARANCE, LARGEST TABLE TOP OF ANY MAGNETIC SAW MADE!

ONLY $17.50

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GET SYNCRO . . the remarkable, safe, patented magnetic jig saw . . ready for immediate shipment! Use for fun or money-making! SYNCRO needs no belt, no gears, no oiling. No motor to buy. Just plug in any 50 or 60 cycle (A.C. only) 110-120 volt wall outlet—in kitchen, attic, basement—set on kitchen table, floor, anywhere—and saw! The high-speed, short Magnetic Safety Stroke Action, and freedom from belts, makes SYNCRO so **safe** small boys and girls may use it. Cuts intricate designs on 5/8" soft wood, 1/2" medium hard plywood and thinner hardwoods, plastics, thin metals. Leaves no ragged undersides on plywood, cardboard. Cuts to center of 27" circle! Get, enjoy this safe, educational, practical quality tool for making models, displays, puzzles, inlays, silhouettes, toys, whatnots, etc. Limited supply—so hurry!

WHY SYNCRO IS SAFEST!

SYNCRO has NO continuous cutting blade nor "Long stroke" blade to pull fingers into teeth—instead there are 14,400 strokes per minute—7,200 short cutting strokes plus 7,200 upward NON-CUTTING, REPELLING strokes! (Fig. 1) SYNCRO will not even CUT wood unless piece is pushed FIRMLY DOWNWARD AGAINST blade and FIRMLY FORWARD—both actions at SAME time! SYNCRO blade teeth cut ONLY on DOWN stroke. (Fig. 2) Teeth raise, repel, push away any object on "UP" stroke. (Fig. 3) When blade moves UP it KICKS finger away free! On down stroke blade does not move far enough to accidently cut finger unless finger is intentionally, deliberately fed into blade like wood is fed in Figure 1. No wonder SYNCRO is the world's SAFEST saw . . . a feature old and young users acclaim!

"Family Saw"

"The SYNCRO POWER SAW ordered from you in 1940 is still sawing merrily away. My son (then 8) has used it in attic, kitchen, his room, and basement shop. I use it too. We never worry about accidents due to its MAGNETIC SAFETY STROKE feature. It's truly a family saw."—Mr. B. H. Smith, Rexburg, Idaho.

Complete with Cord, 3 Blades

ORDER NOW ON 10 DAYS TRIAL!

Order with **complete confidence** on **this** liberal Trial Offer: When you get your SYNCRO, plug it in and saw, as per directions. Then, if it does now saw **cleaner, better** than any other jig saw you ever used, and with more safety . . . if it does not satisfy YOU . . . return it undamaged, postpaid and post-marked within 10 days of its delivery date . . . and we will refund the saw price promptly without question!

15 OUTSTANDING SYNCRO FEATURES:

(1) World's safest saw. **(2)** Portable. **(3)** No rotating motor needed as self-contained magnetic power unit transmits A. C. magnetic impulses to armature diaphragm—power transferred to blade. **(4)** No rotating parts to wear out. **(5)** 14,400 magnetic strokes per minute. **(6)** Never needs oiling. **(7)** Large 10" x 10" table top. **(8)** Cross section engraved lines on top. **(9)** Big 13 1/2" throat clearance. **(10)** Finest steel blades. **(11)** Rubber feet. **(12)** 5' cable, plug. **(13)** Varying voltage adjustment nut. **(14)** Lifetime durability. **(15)** Quality materials, workmanship, performance . . . guaranteed by the famous "SYNCRO" trademark name.

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Export Address: 120 Wall St., N.Y.C.

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Please ship saw:
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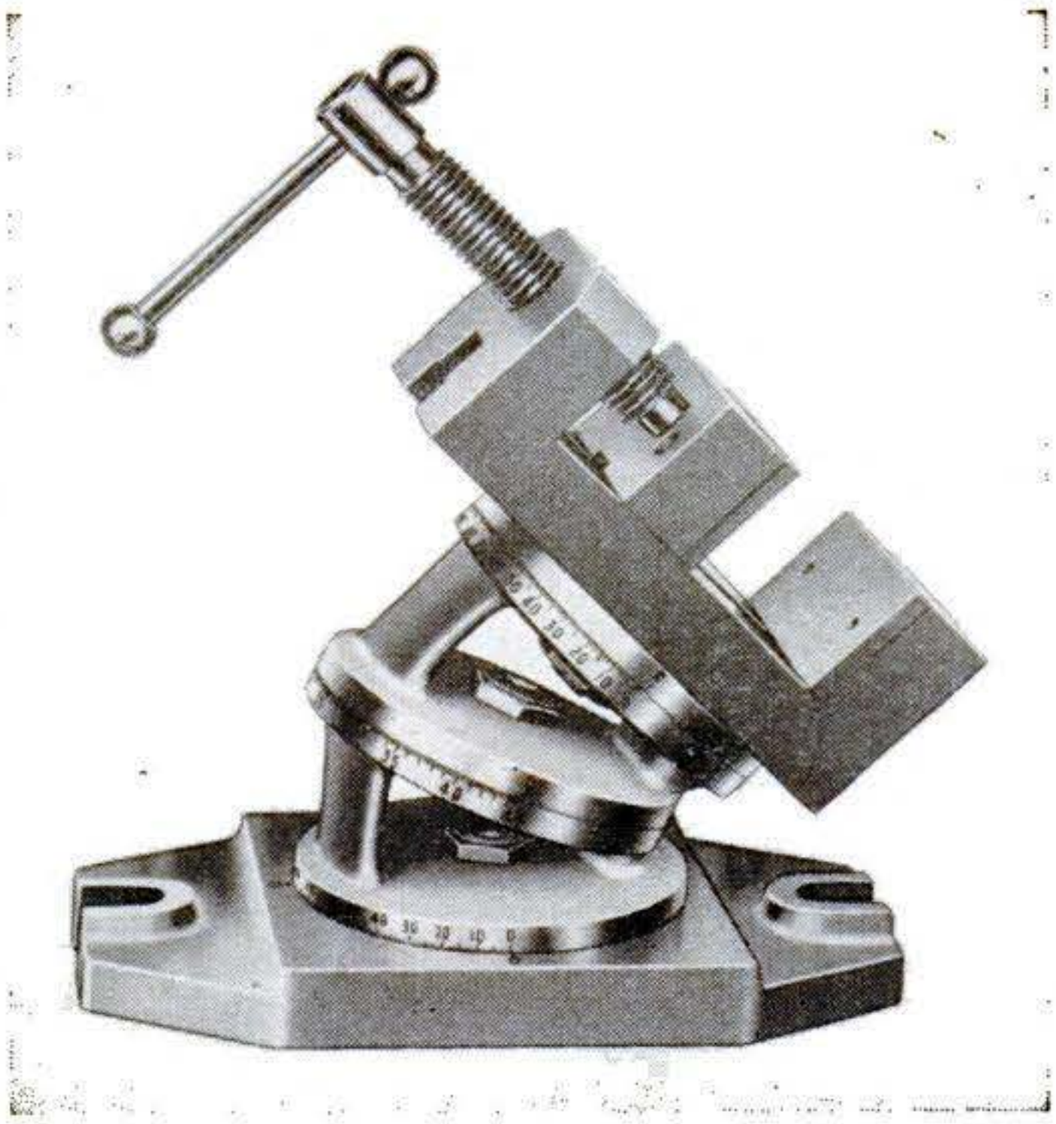
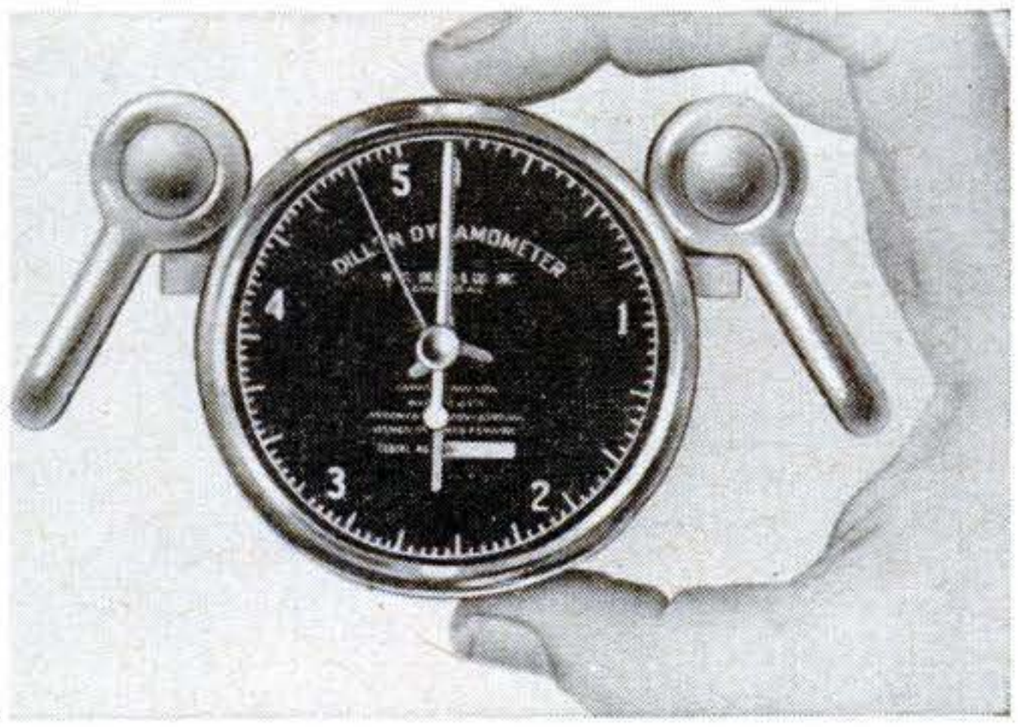


New Vise Is Versatile

THREE circular swivels on this Uni-Vise are interchangeable, making possible its use as a single, double, or triple swivel tool. The jaws of the vise itself are mounted on the top plate in either vertical or horizontal position. All these variations are adjusted by only three hex bolts, each working independently of the others. Made by the Union Tool Corp., of Warsaw, Ind., the angle-swivel vise weighs only 13½ lb.



Miniature Dynamometer

DESIGNED for measuring tension or force in the limited spaces found in many mechanical assemblies, this new dynamometer, made by W. C. Dillon & Co., of Chicago, is three inches in diameter, weighs only one pound. It has an unbreakable lucite crystal, a red maximum hand, and a black dial with etched silver numerals. Believed to be the smallest of its kind, it comes in 100-lb., 250-lb., and 500-lb. capacities.

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MOTO-TOOL ★ The "Pocket-Size Machine Shop"

ELECTRIC DREMEL POWER TOOLS

A TOOL THAT PACKS EXTRA YEARS OF PLEASURE . . . LOOK AT THE REST, THEN BUY THE BEST

Here's a tool to please a man's heart . . . one that holds promise of endless creative hours. Dremel Moto-Tool is a "war-veteran" . . . used by all branches of the Armed Forces in far-flung repair bases . . . helped to set production records at General Electric, Westinghouse, Remington Arms, Ford and others. Hobbyist or expert craftsman, first choice is Model 2 Moto-Tool Kit with its handsome felt-lined, highly finished wood case with rows of tools begging to be put to work. Write for FREE catalog of Moto-Tool attachments and accessories.

PRE-WAR PRICES STILL PREVAIL

Moto-Tool Kit No. 2, with 23 accessories **(high speed steel** cutters, grinding wheels, polishing accessories) and heavy-duty professional Model 2 Moto-Tool in natural-finish, hardwood case .....**$23.50.** (Items purchased separately would cost about $30.00; you save $6.50.) **Moto-Tool No. 2** with one emery point **$16.50. Moto-Tool Kit No. 1** with 34 accessories and Model 1 Moto-Tool in wood case ....**$17.50. Model 1 Moto-Tool** with one wheel point **$9.85.**

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Free Both Hands With Moto-Tool Attachments

Moto-Tool Stand (left) made of heavy cast iron, holds Moto-Tool at any position or angle **$4.50.**

Moto-Tool Shaping Table $2.50. (Shown with stand, right). Aids accuracy in routing, grinding.

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Buy Dremel Moto-Tool from your Dealer. If he cannot supply you, order direct from factory on 10 day trial. Shipped postpaid for payment in full (send check or money order); or send only $2.00, we will ship C.O.D. You pay balance plus postage.

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Vibro-Tool complete with 22 attachments in handsome, polished wood chest.....**$16.50**

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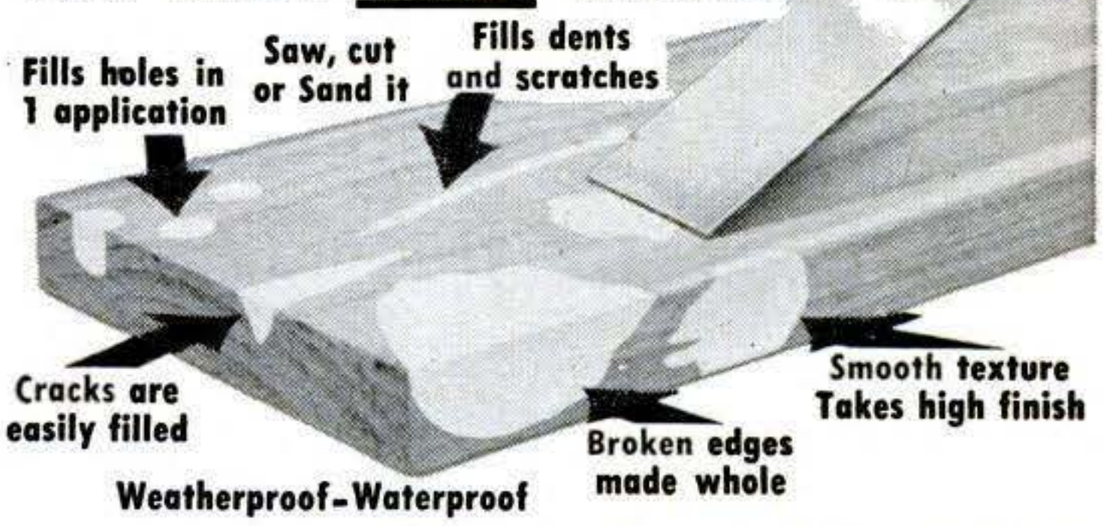

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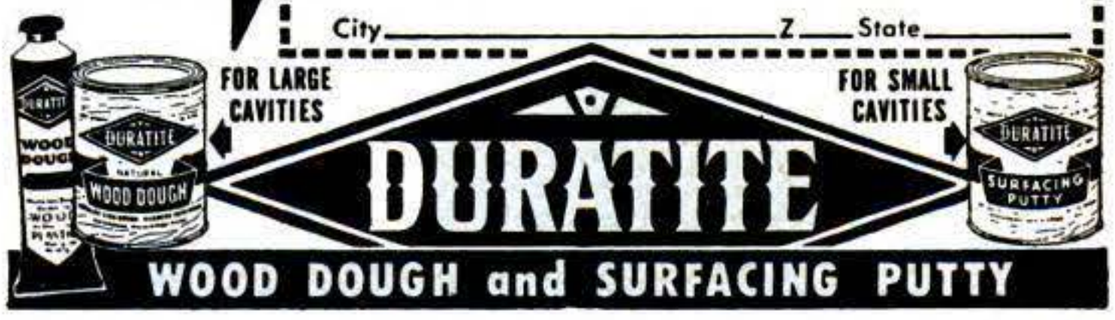

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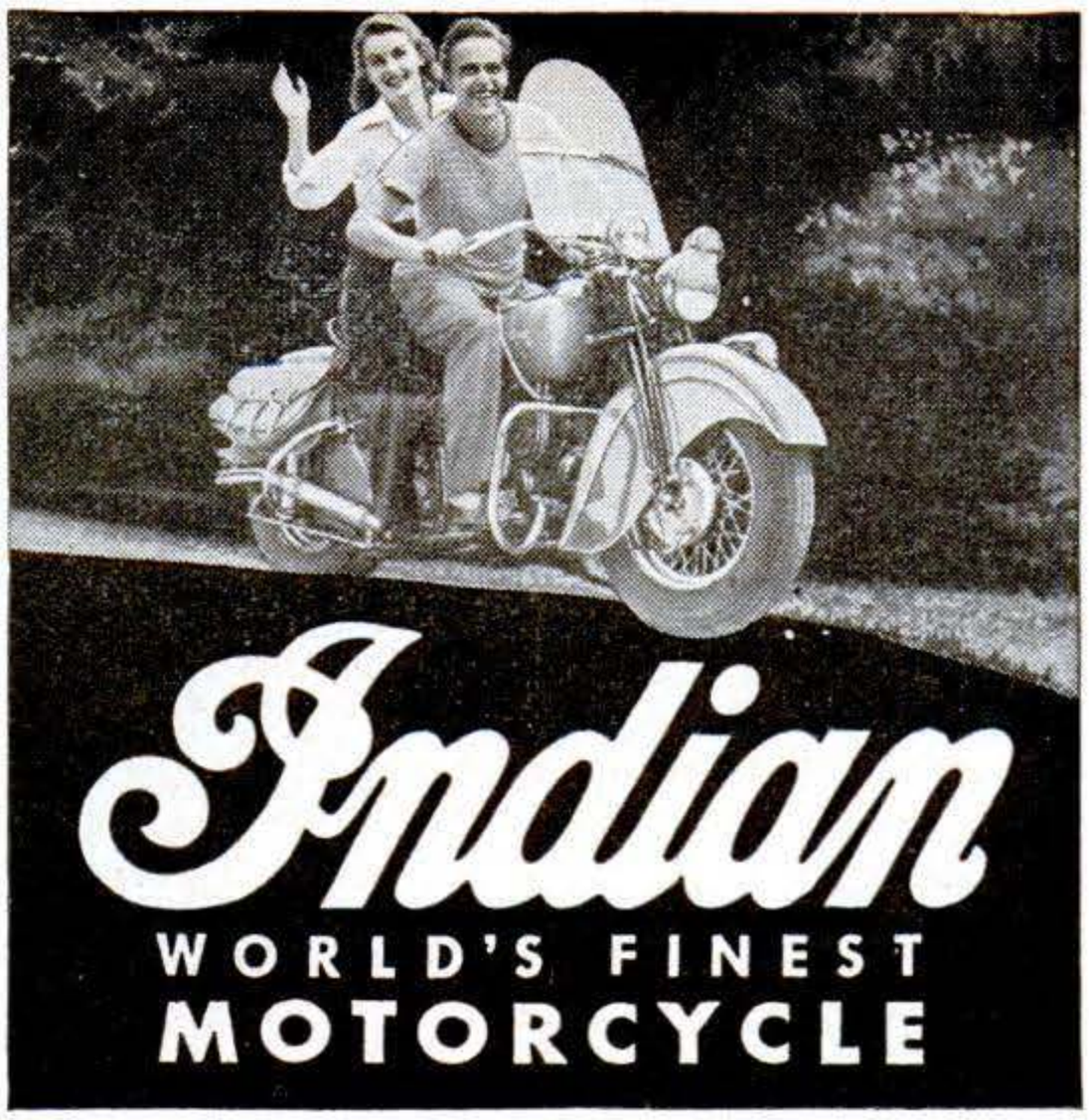

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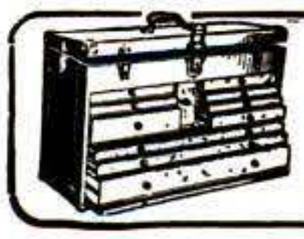

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Tear out coupon and mail today!

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☐ Please send complete information on the Carvit.

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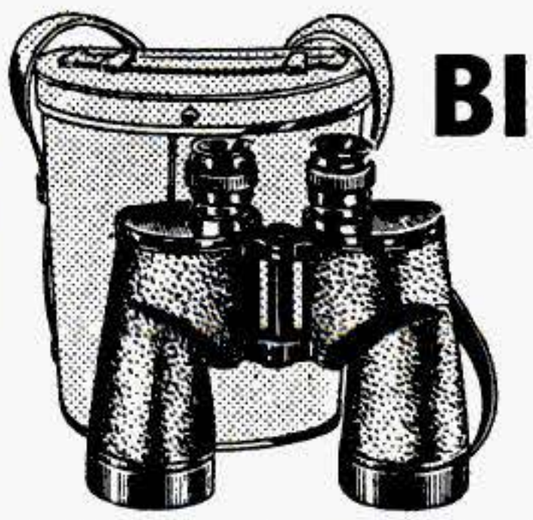

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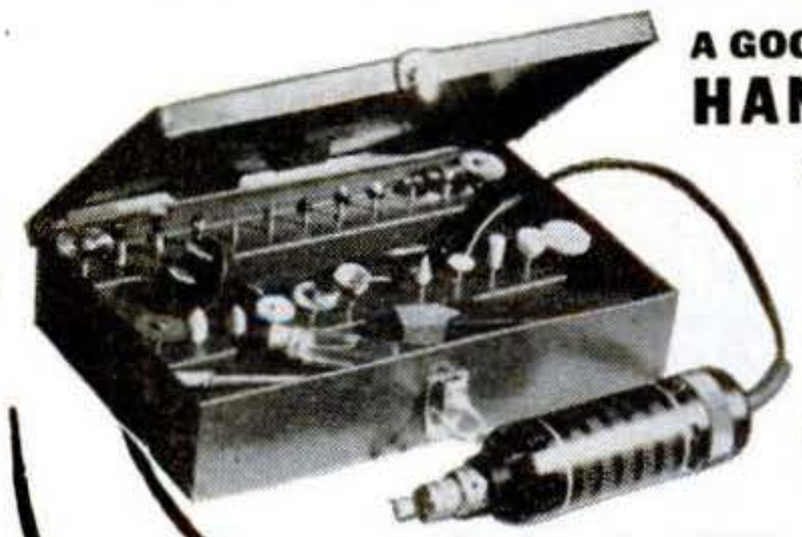

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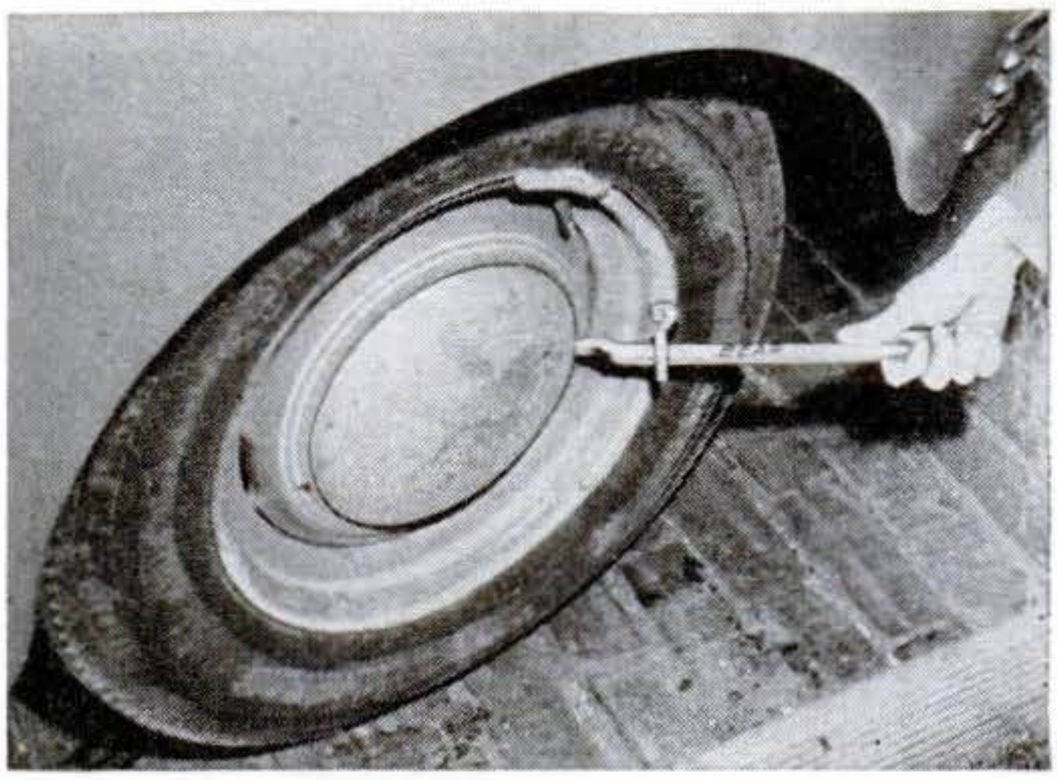
Midget Radio Has Power

OPERATING on hearing-aid batteries and using a tiny war-developed tube, this miniature radio claims 100-mile reception. A wire clipped to any handy metal object provides the aerial. The listener uses earphones and has complete dial tuning and full band selection. The set is about 4½ inches wide and three inches high and is molded from Tenite plastic. It is made by the Modernair Corporation, of Los Angeles.



Won't Dent Hub Caps

ONLY slight pressure is needed to remove hub caps with this new tool, thus preventing any danger of denting or marring. Designed to remove every type of concealed hub cap on all makes of cars, it can also be used to remove front wheel grease retaining cups. It is a product of the Bear Manufacturing Co., of Rock Island, Ill.

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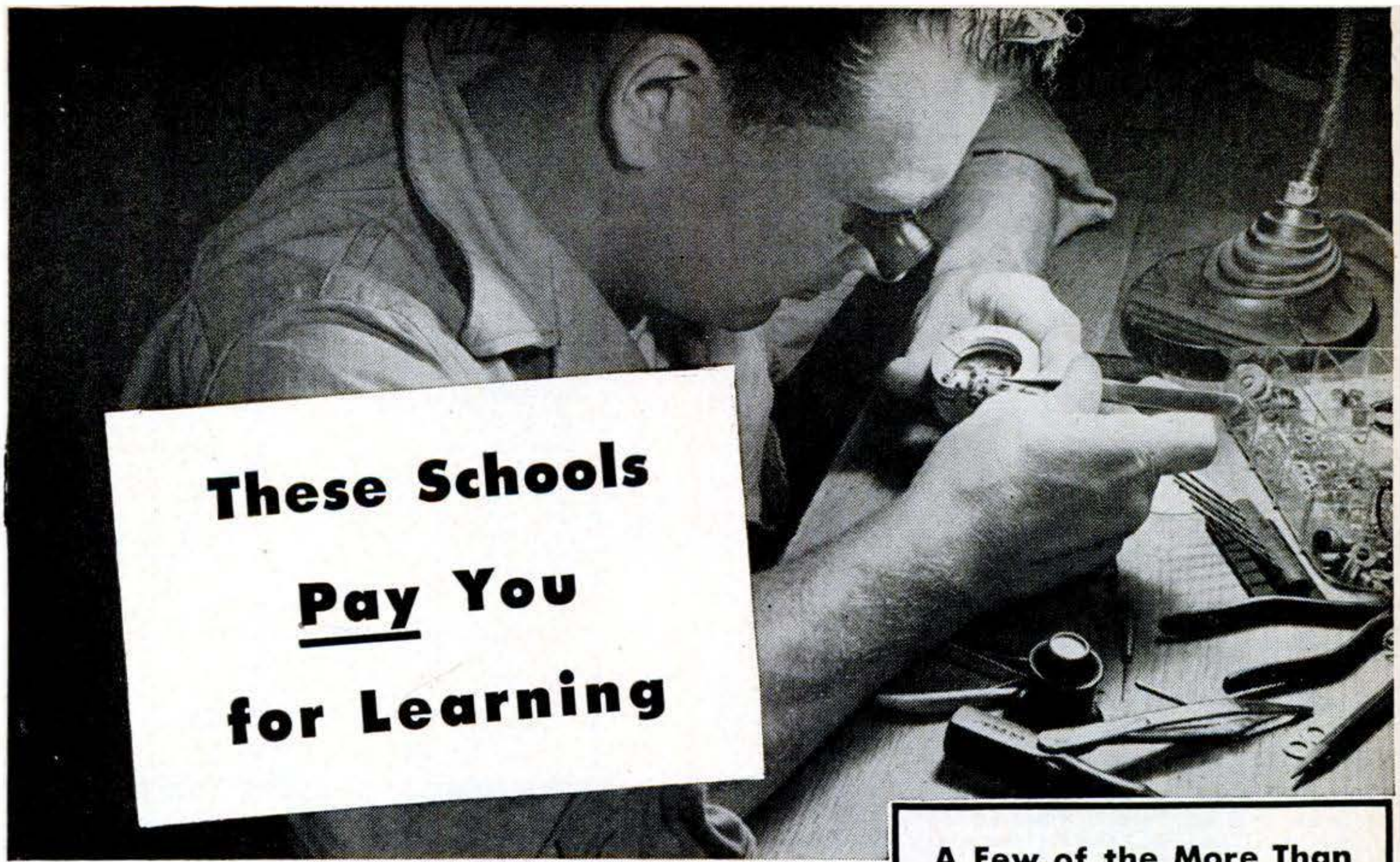

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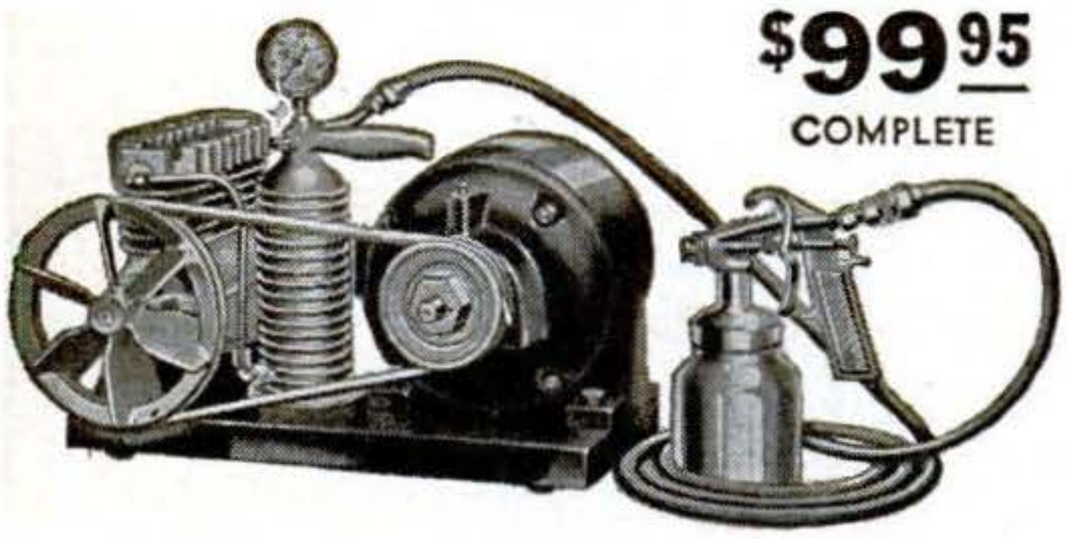

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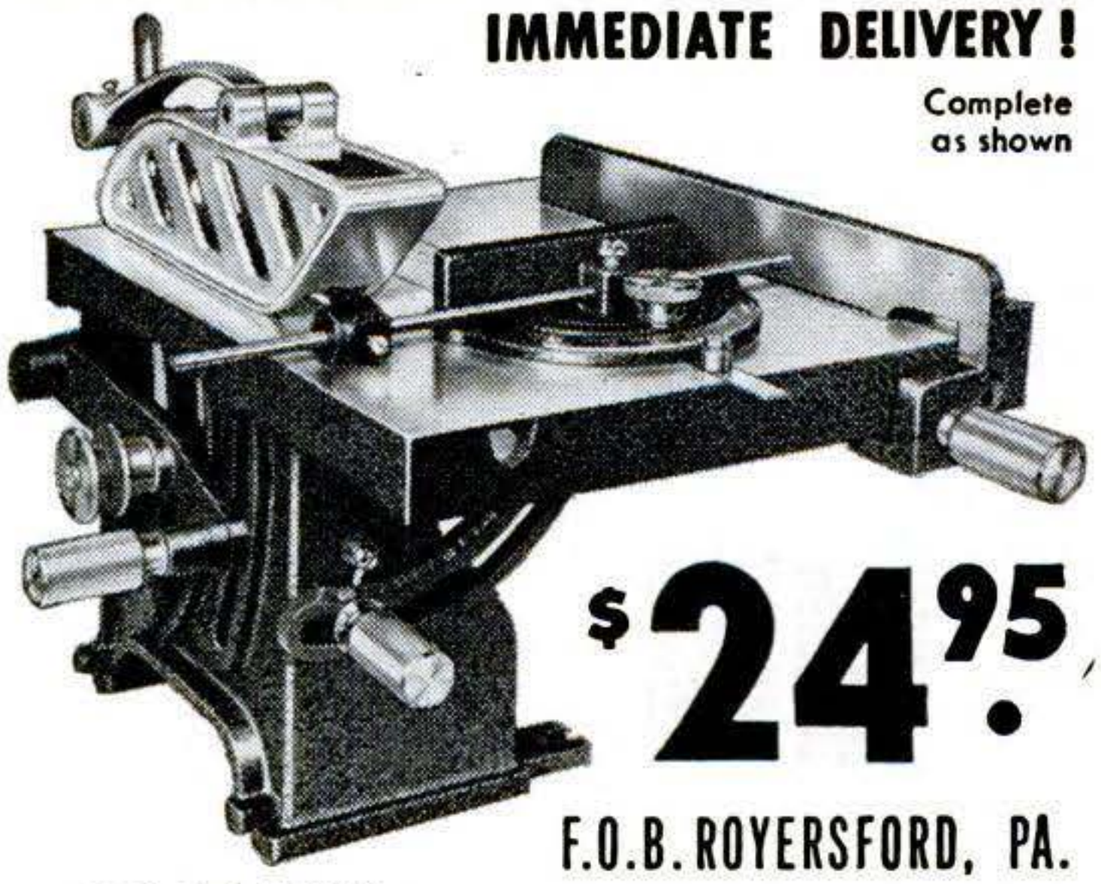

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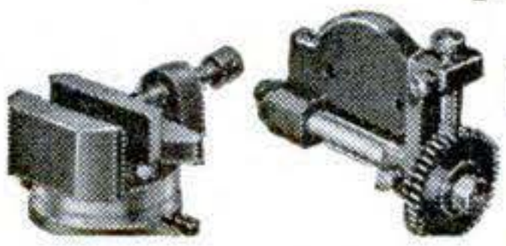

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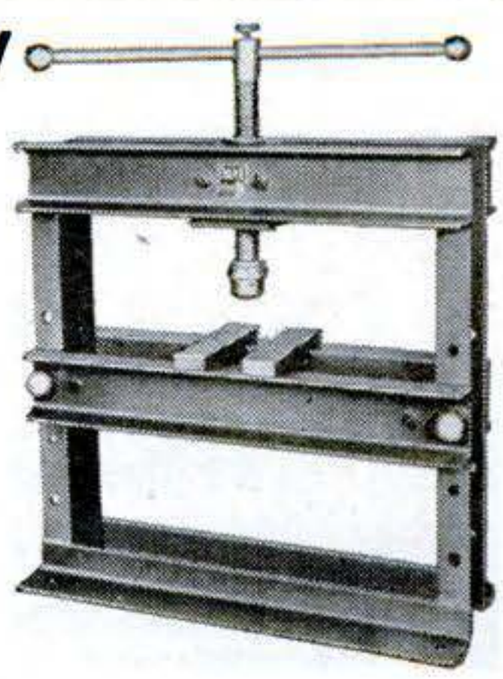

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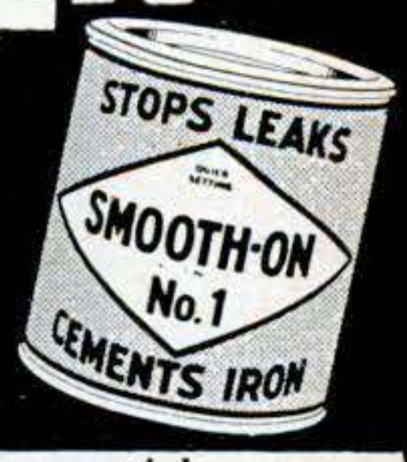

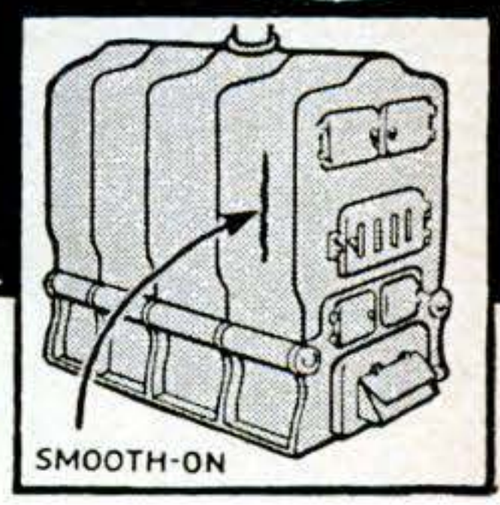

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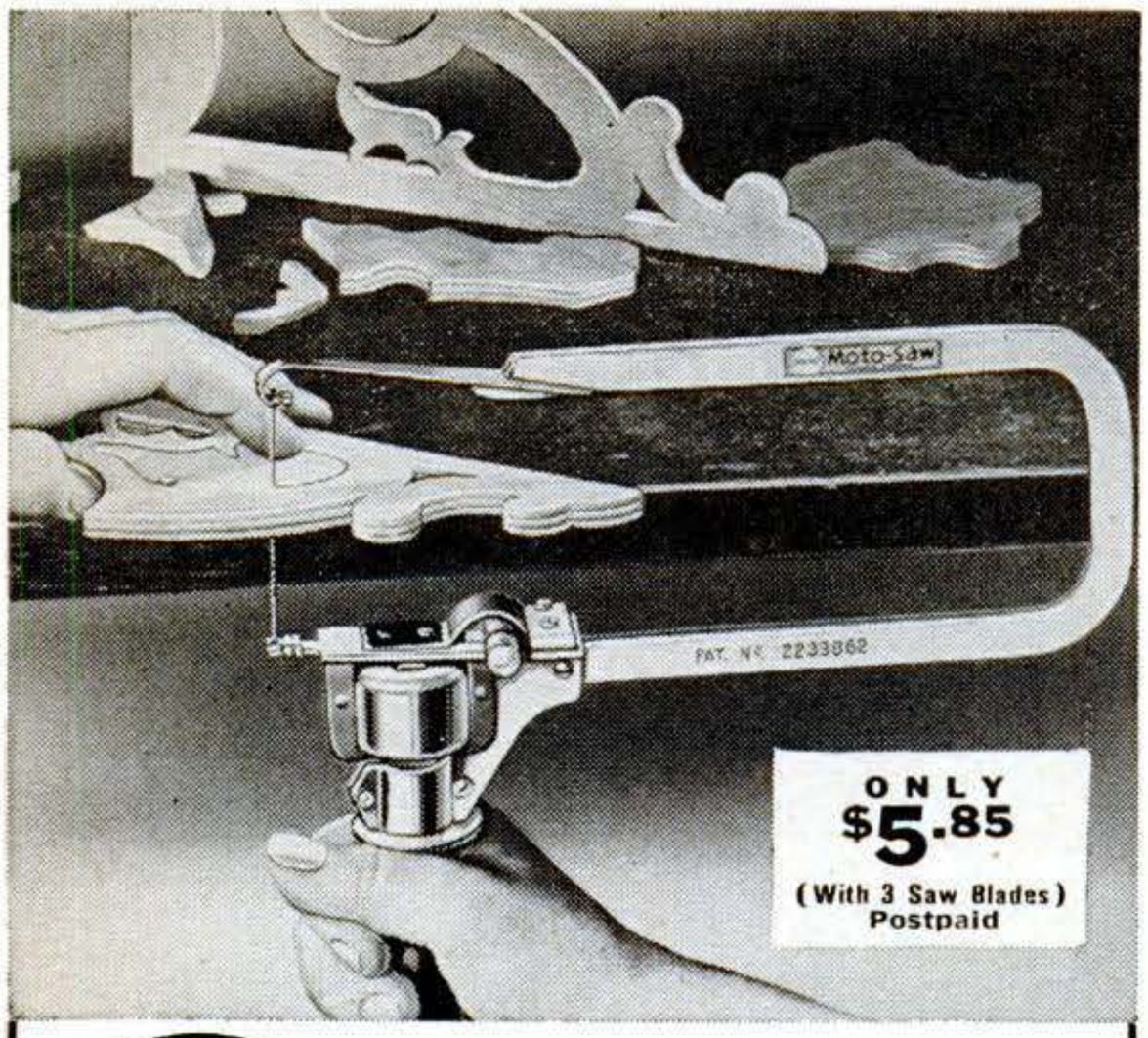

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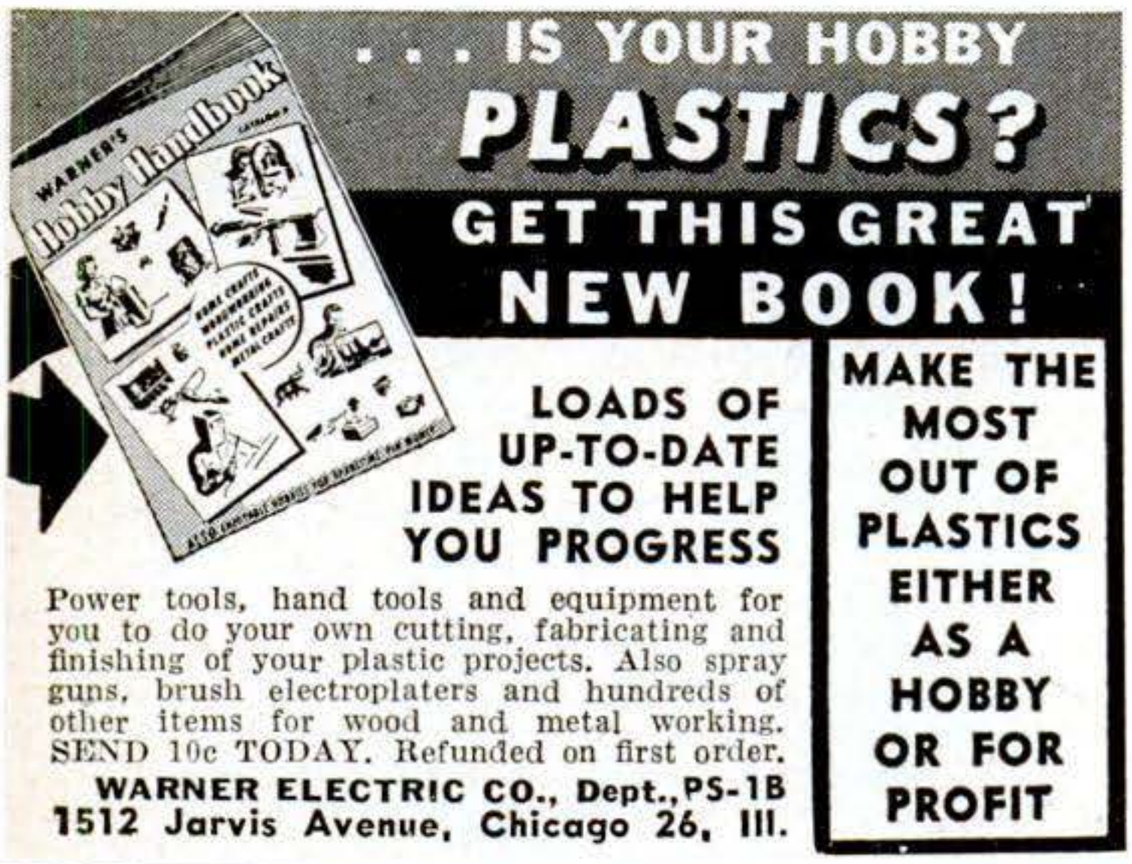

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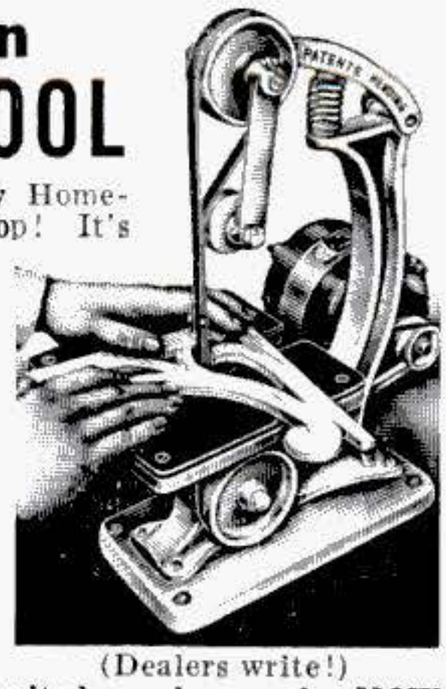

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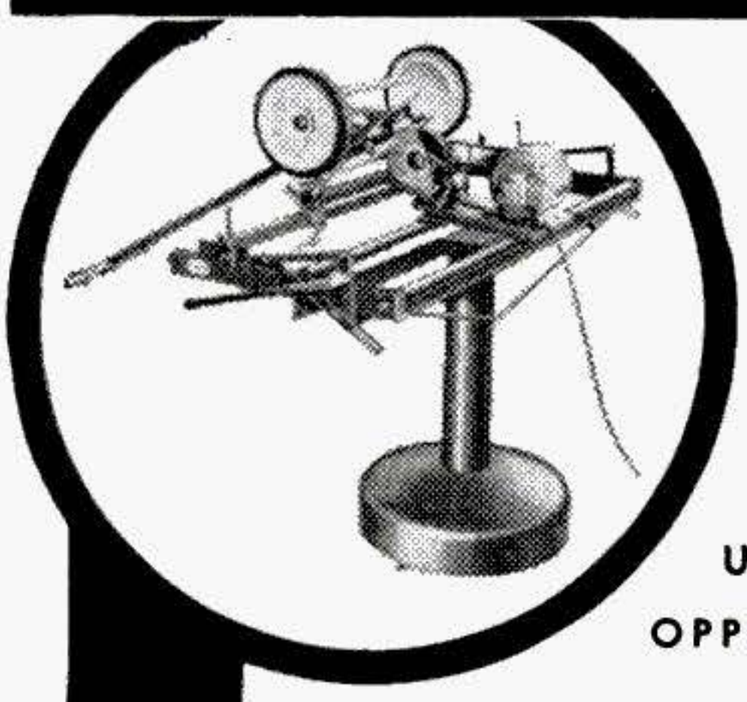

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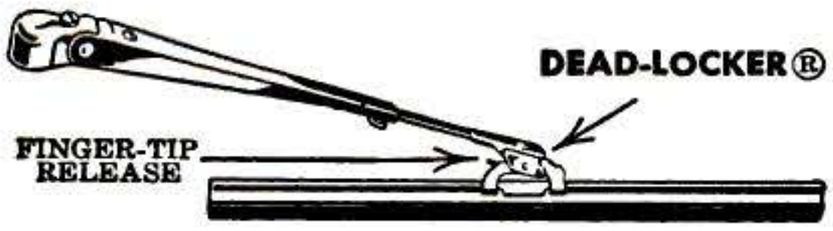

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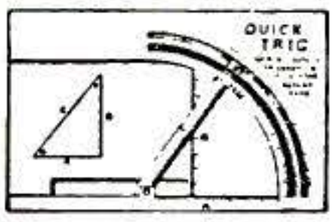

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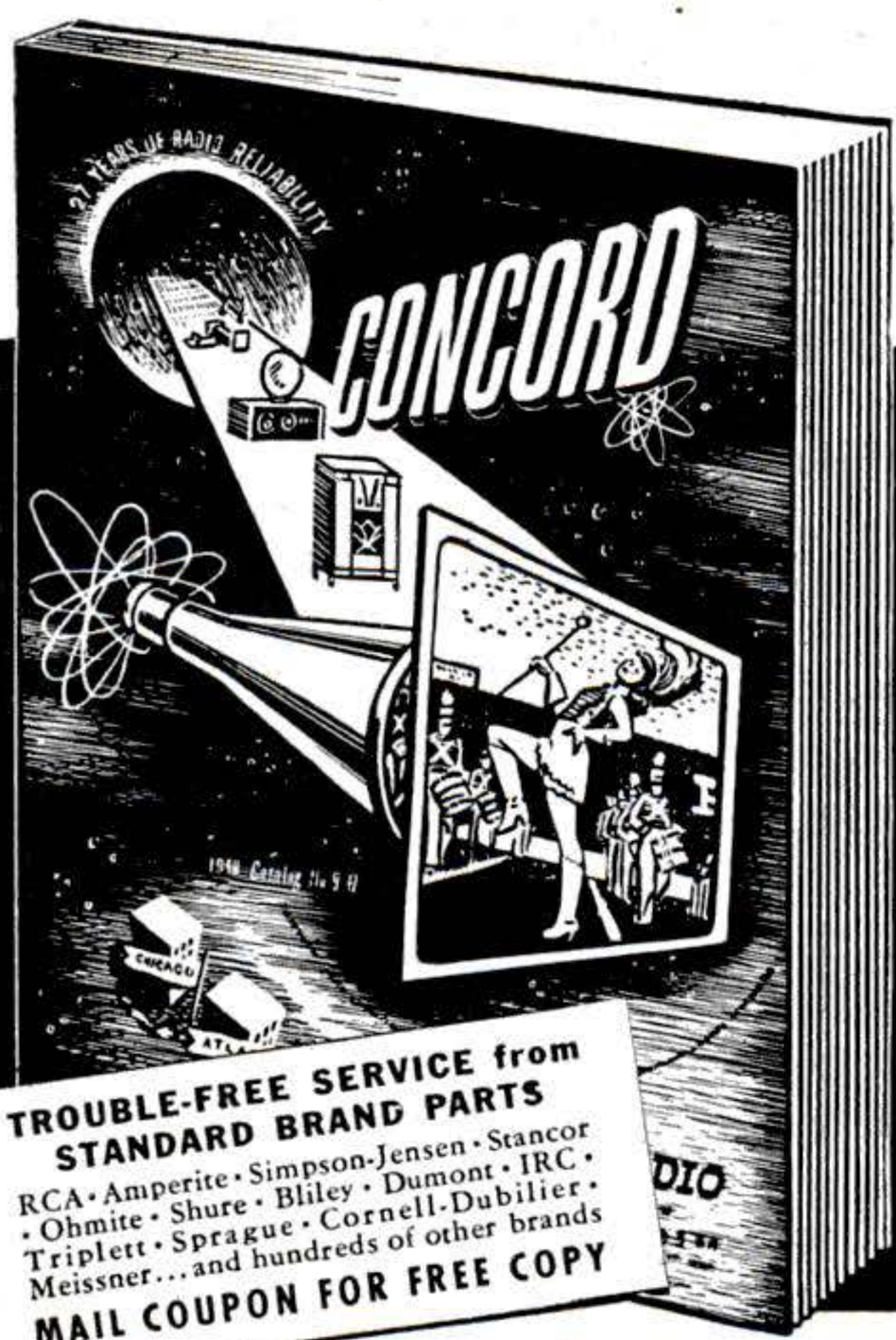

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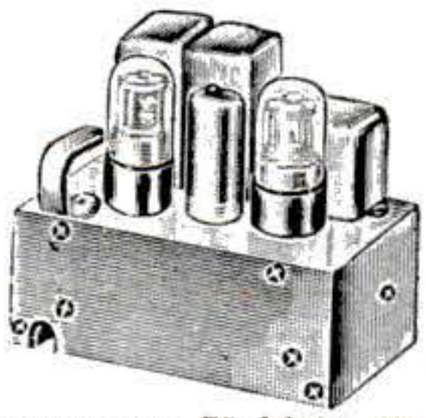

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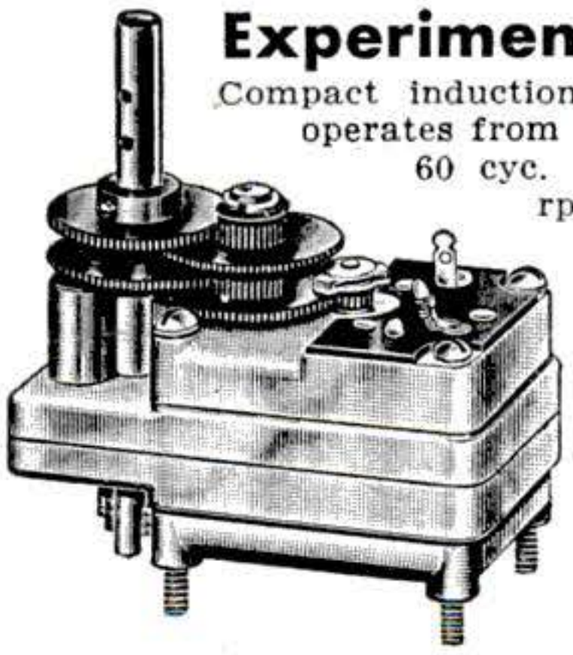

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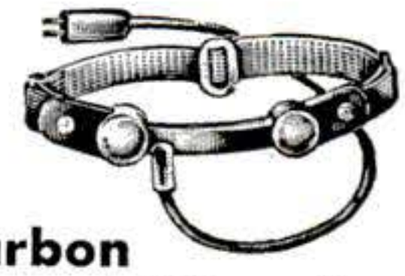

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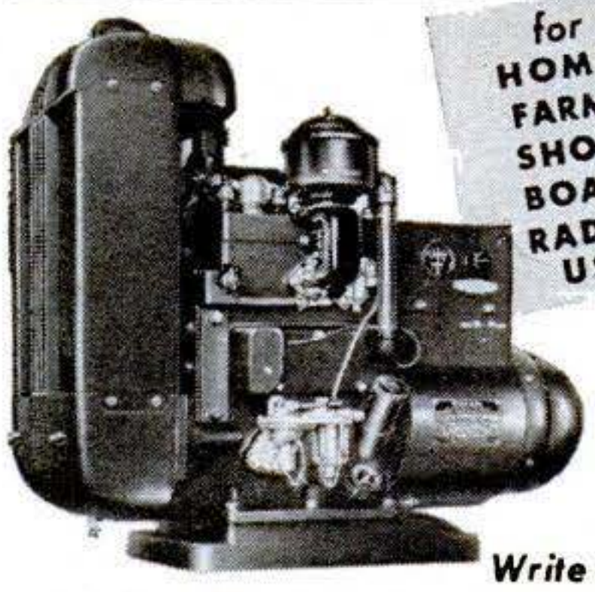

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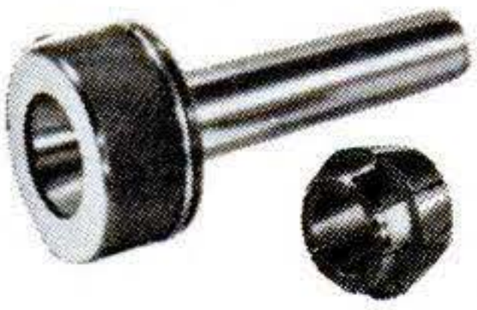

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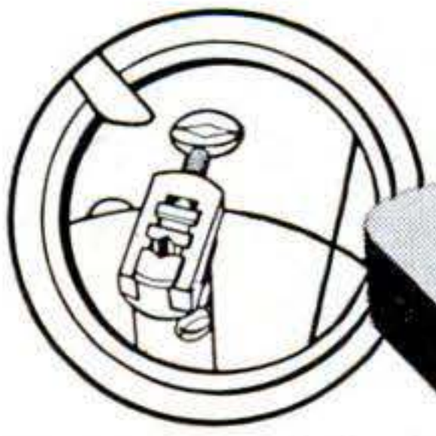

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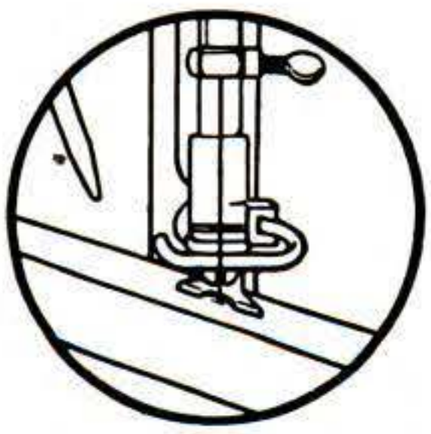

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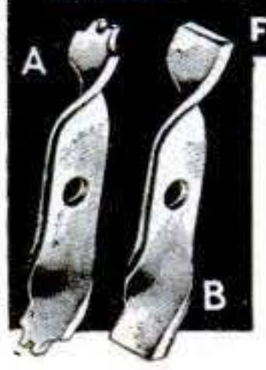

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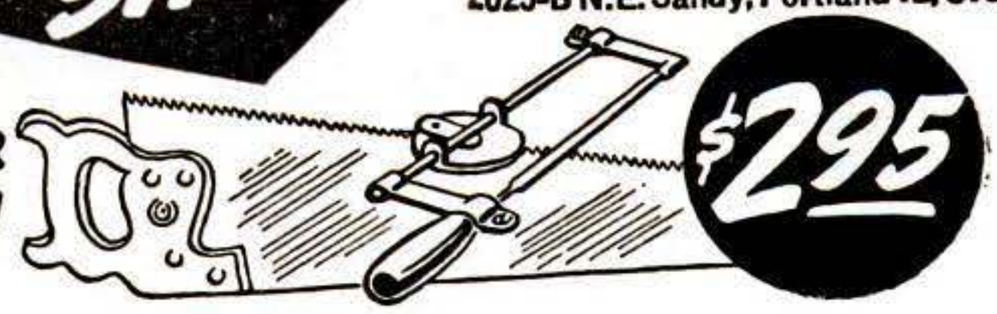

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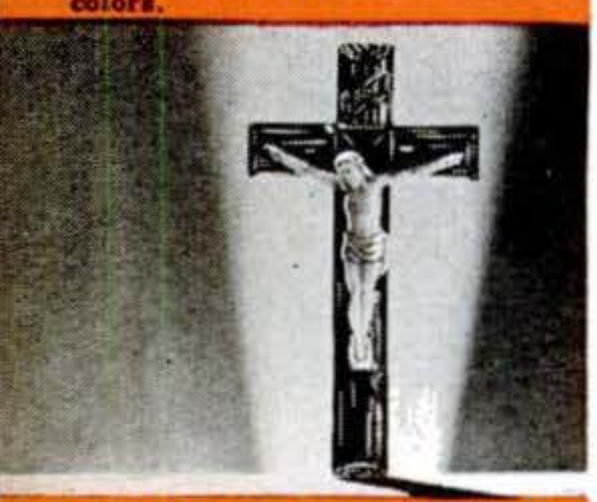

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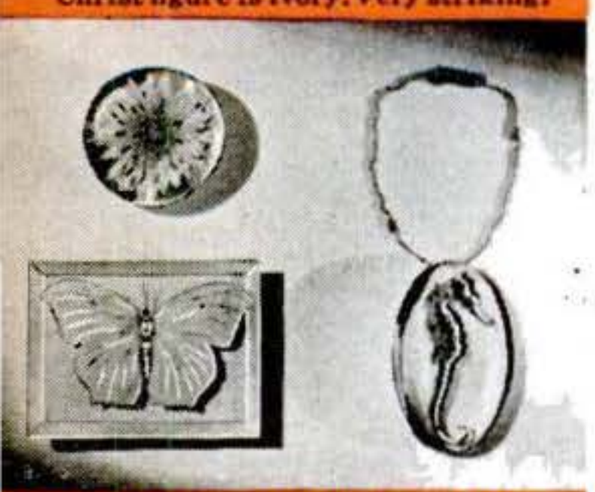

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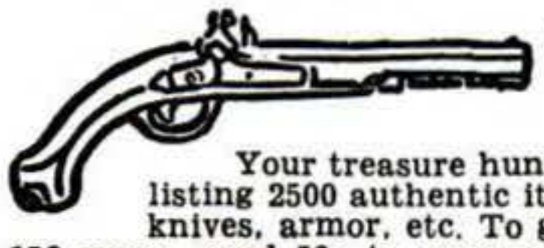

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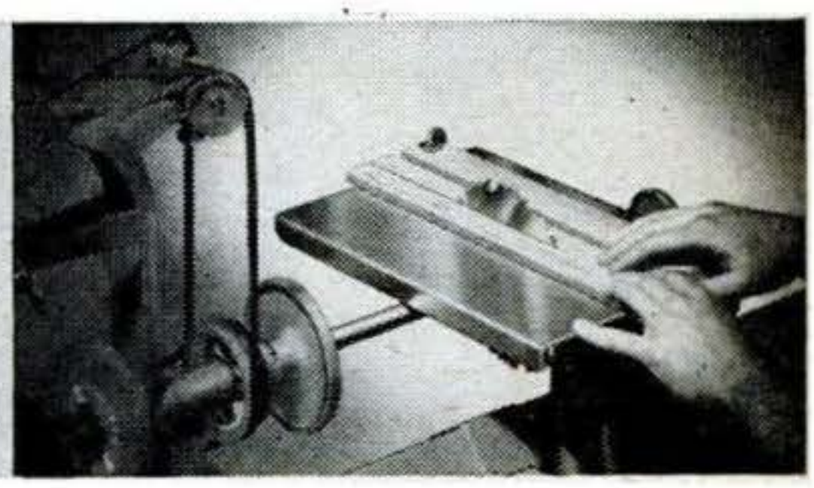

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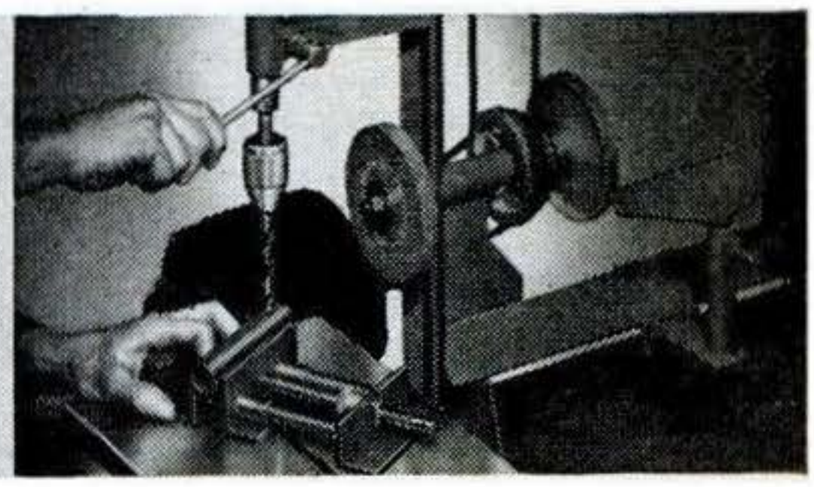

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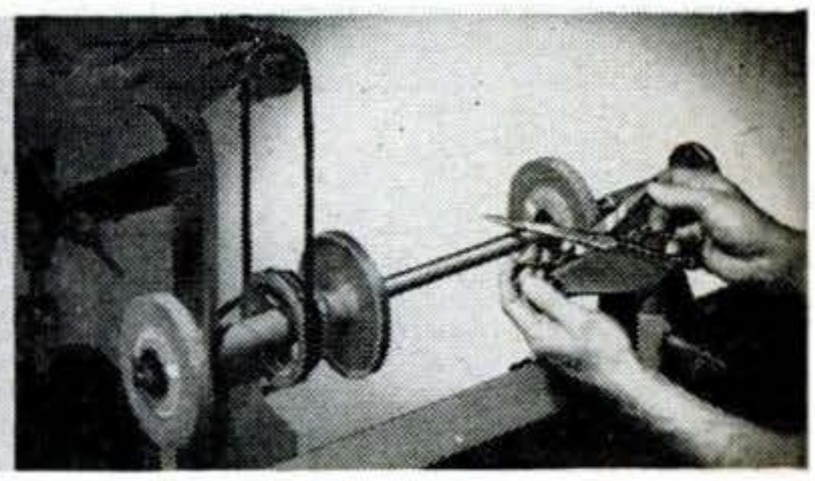

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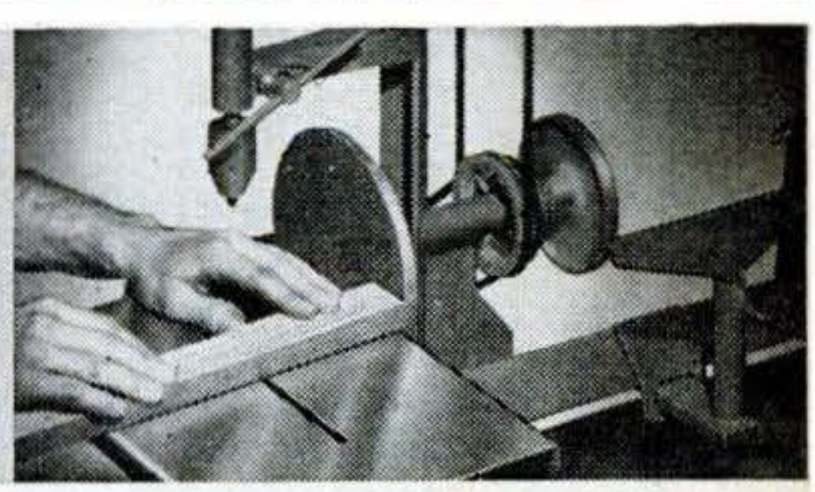

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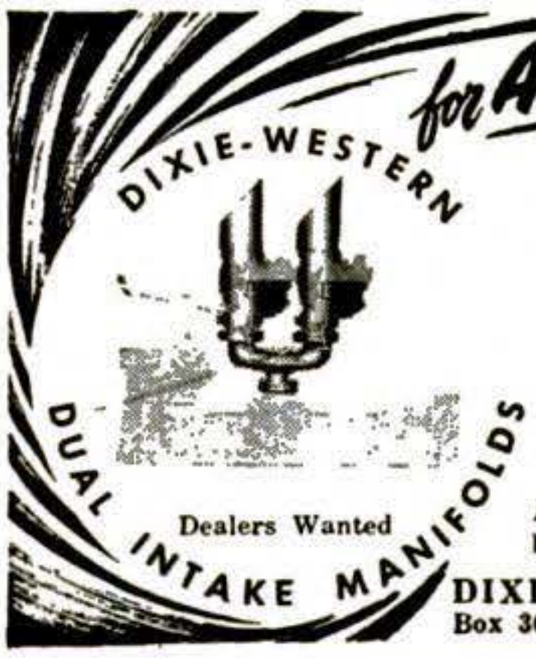

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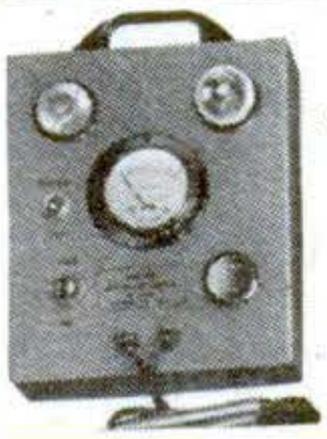

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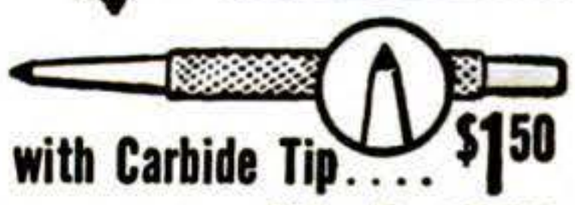

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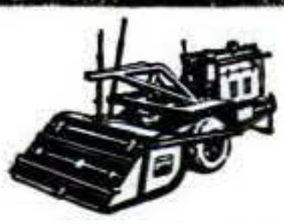

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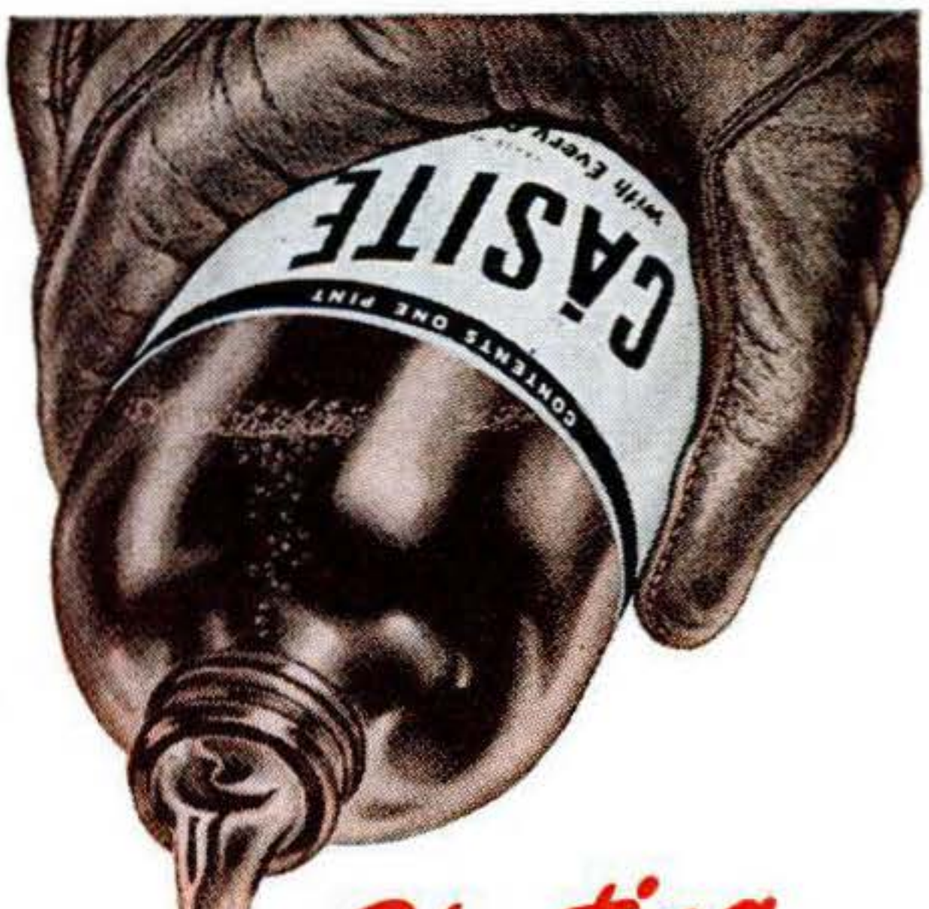

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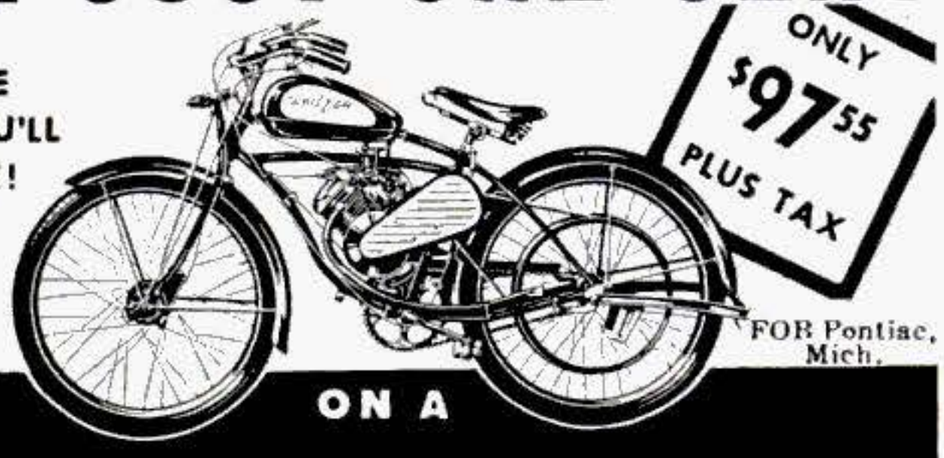

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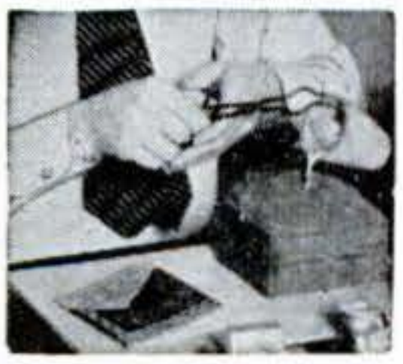

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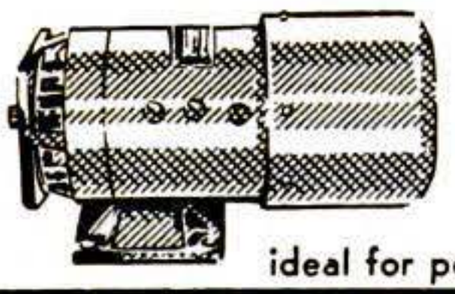

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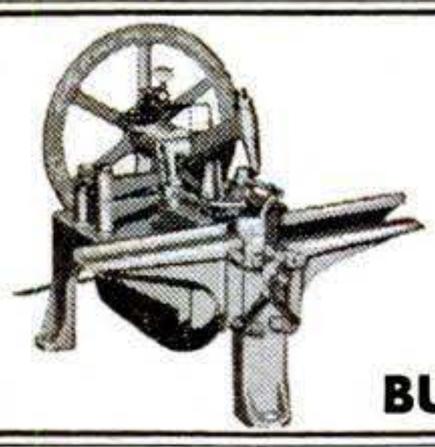

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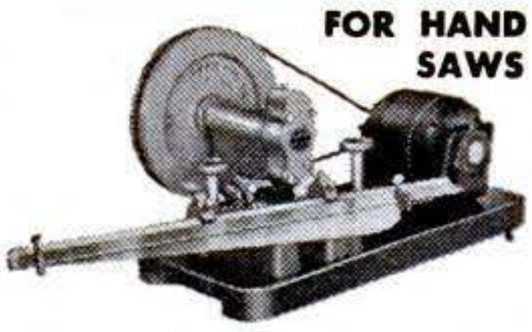

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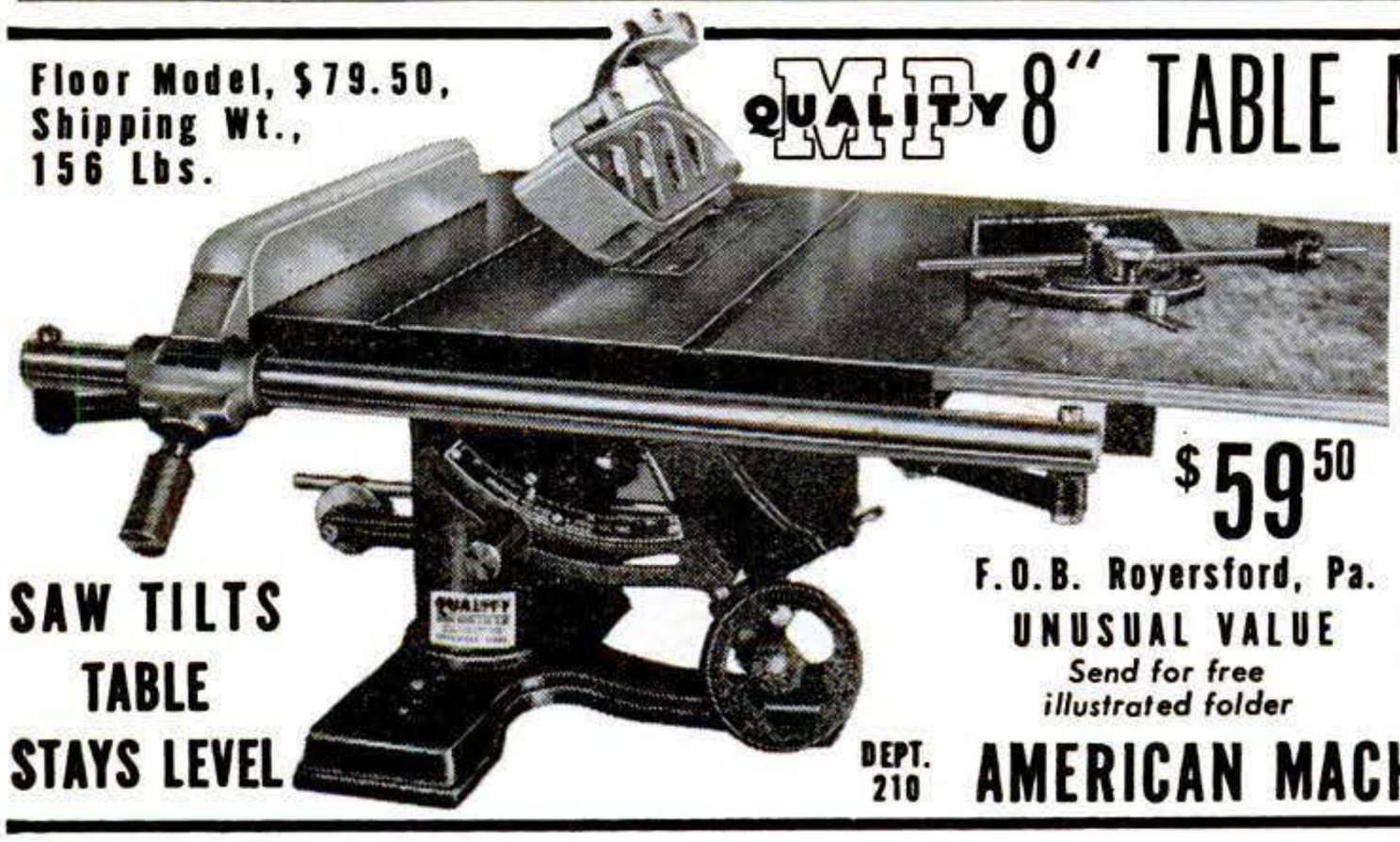

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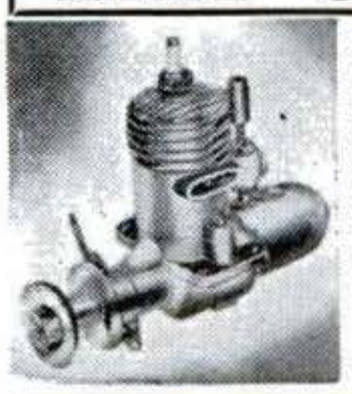

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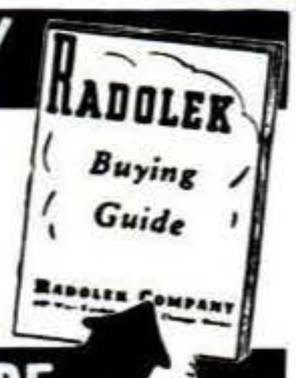

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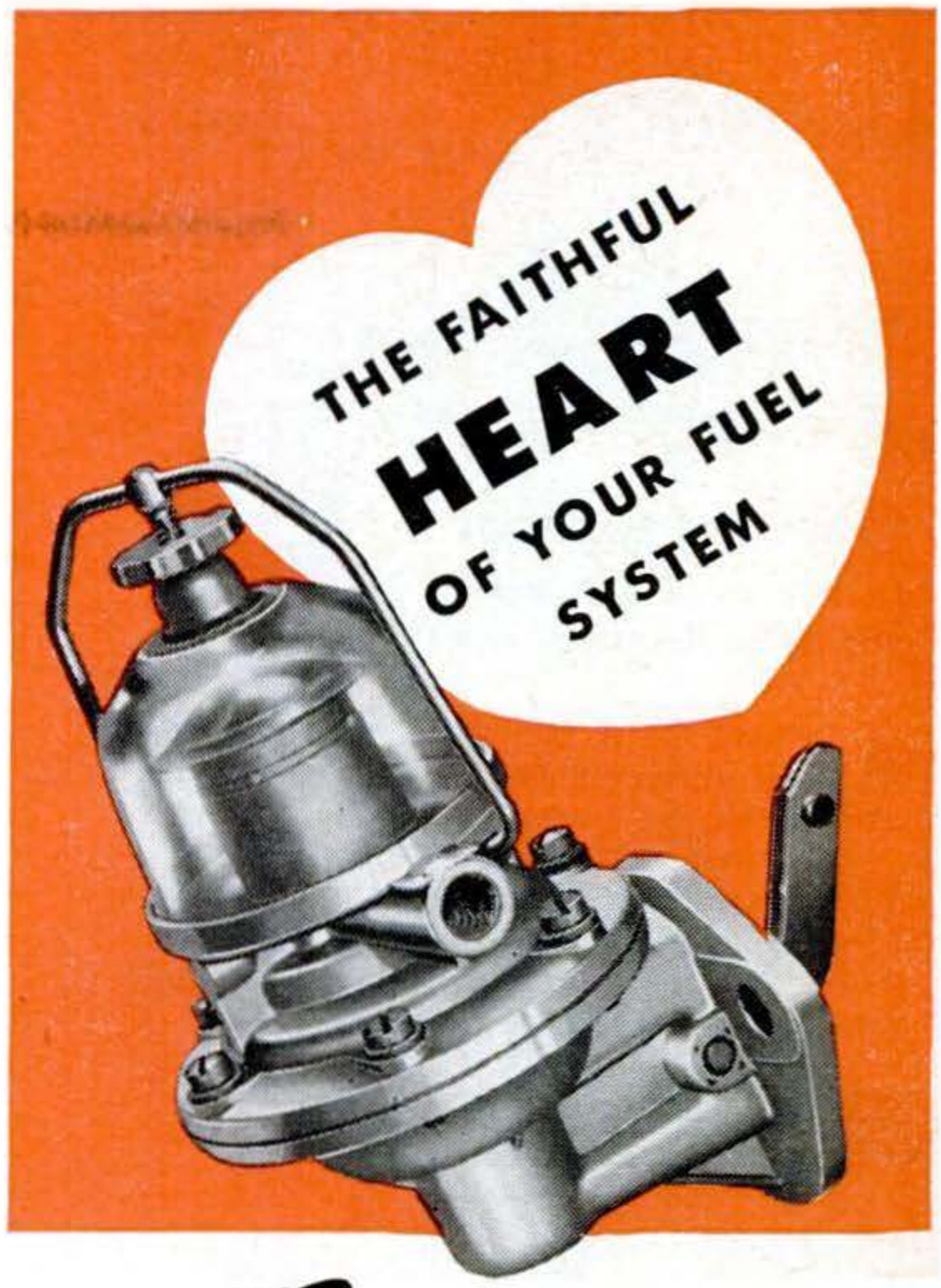

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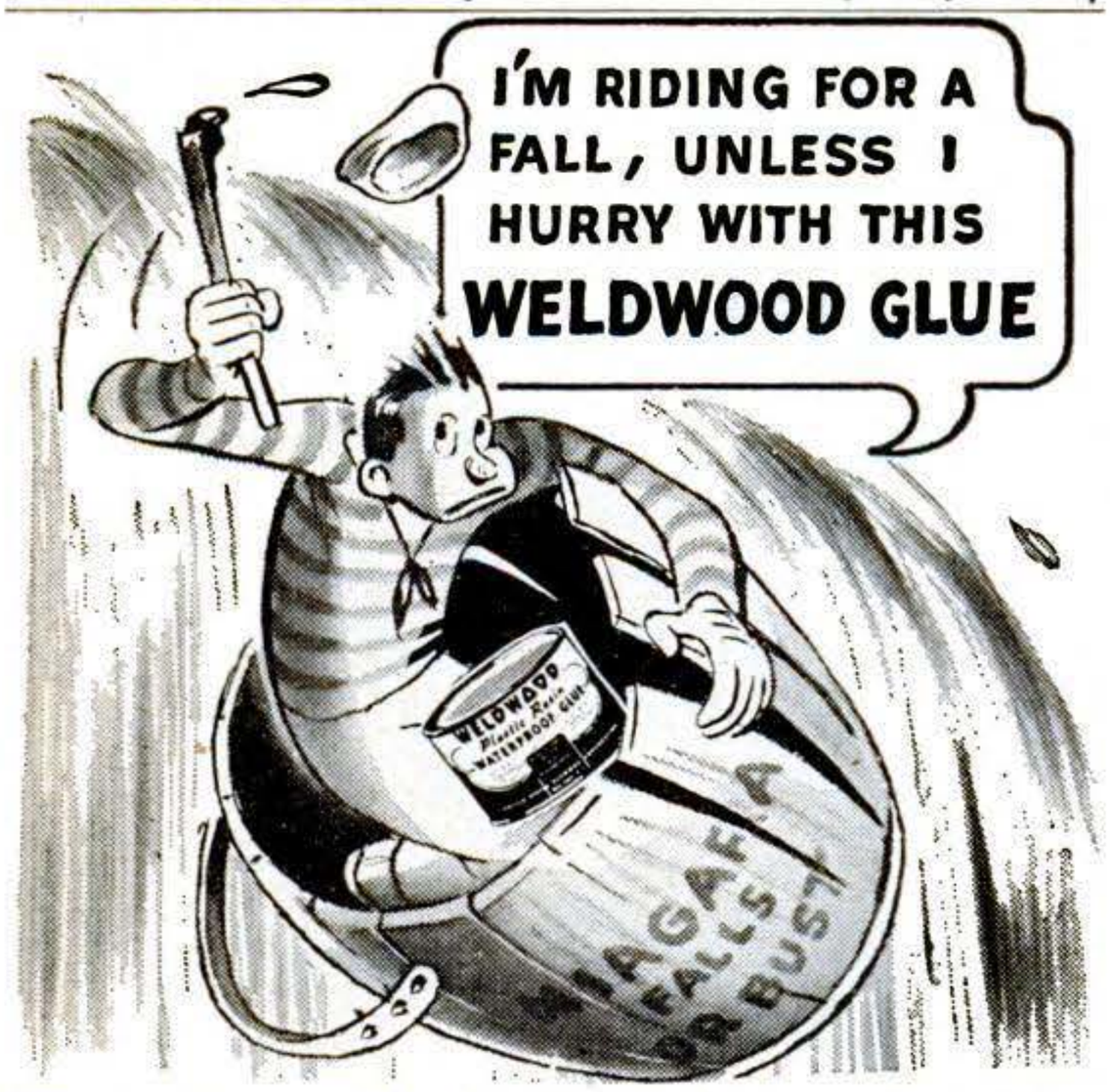

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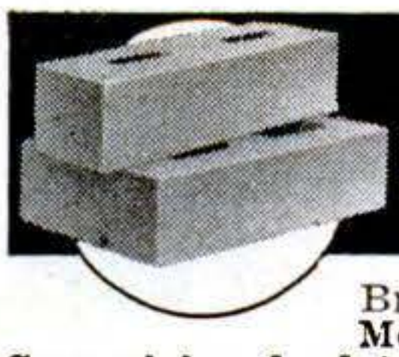

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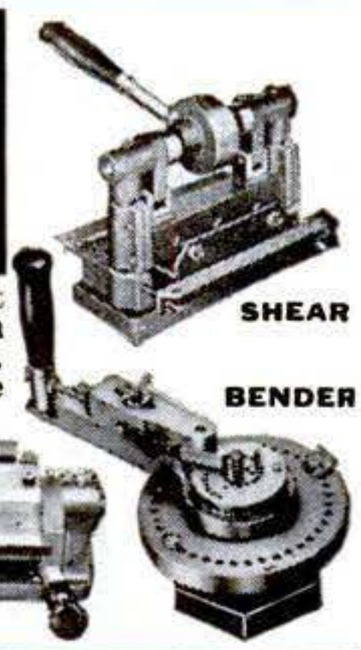

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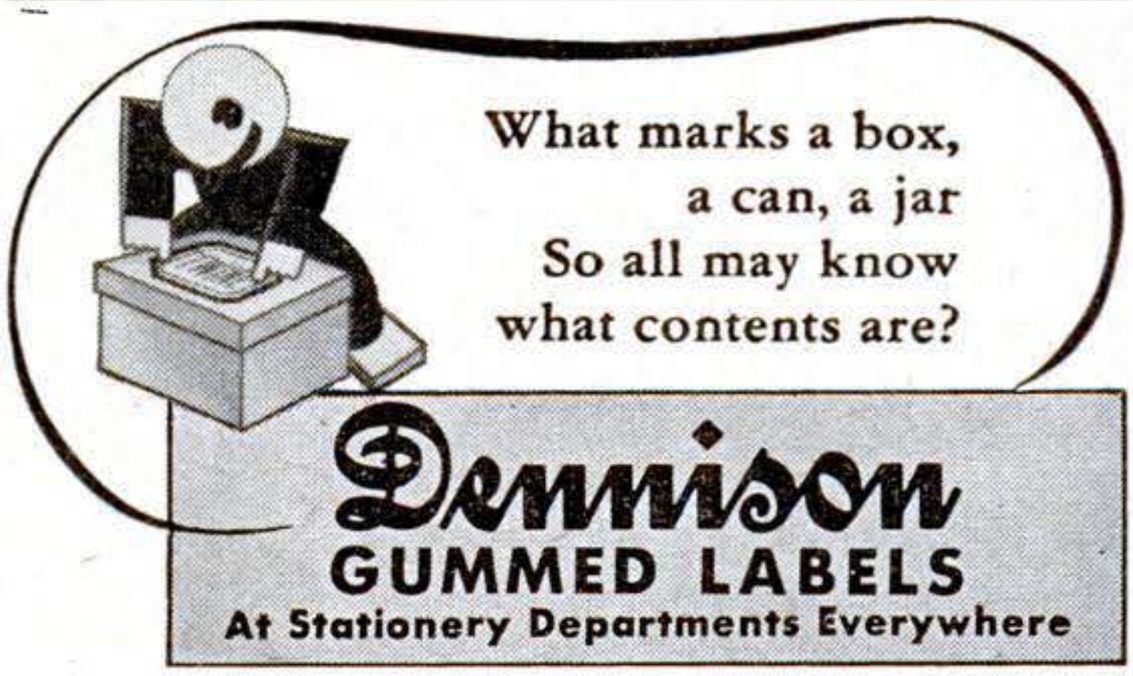

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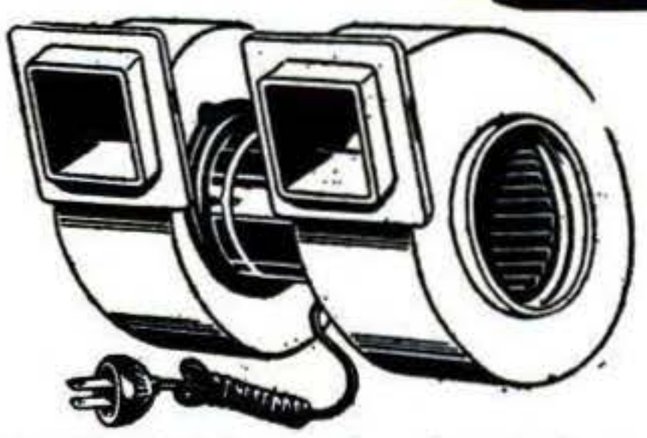

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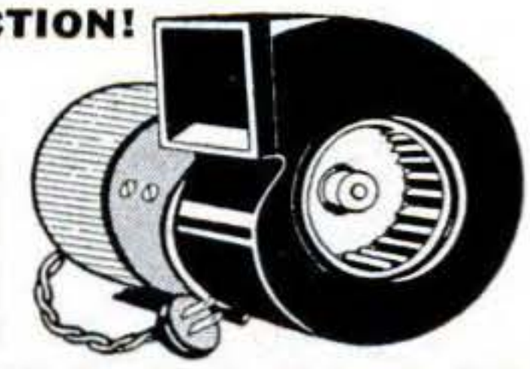

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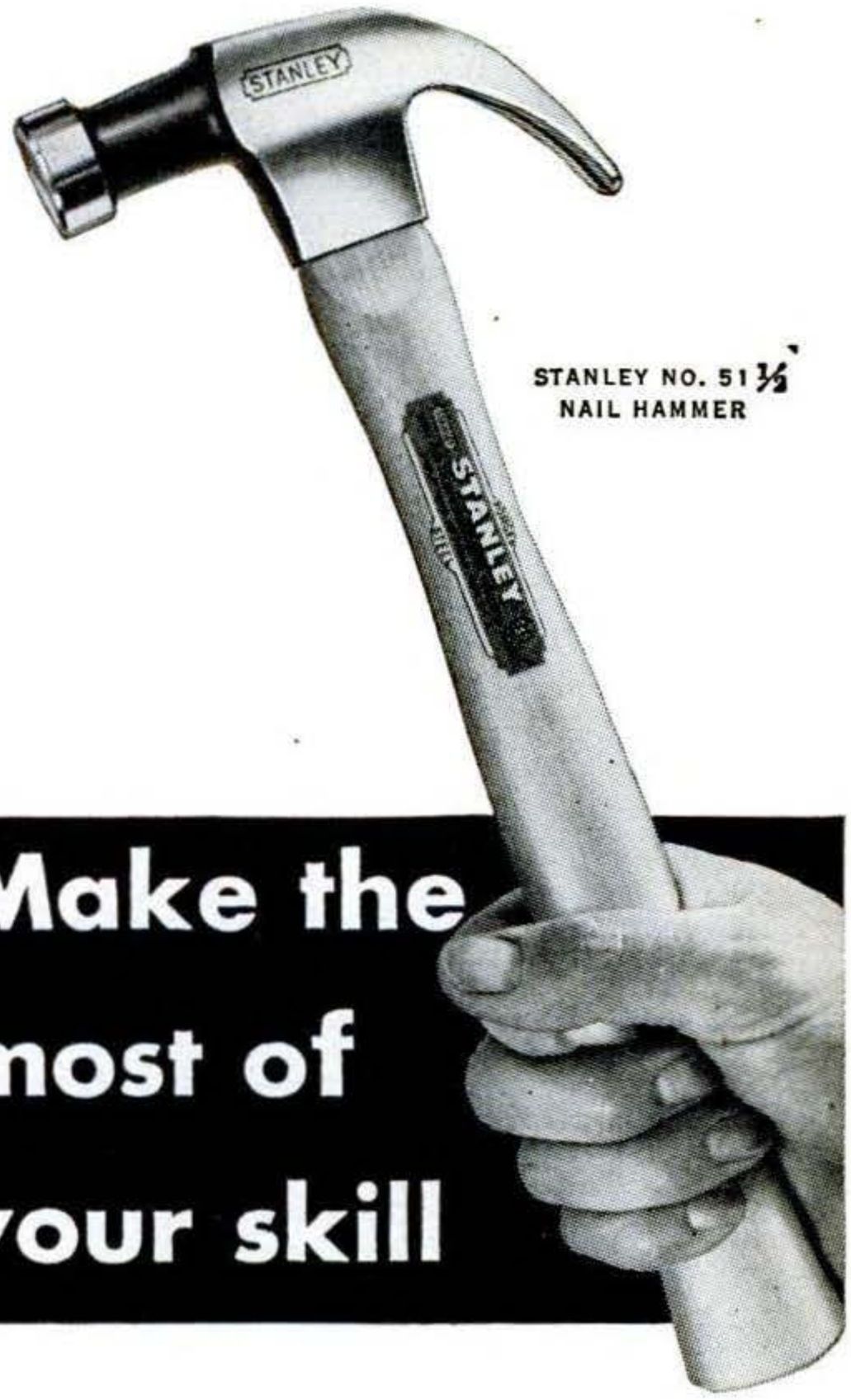

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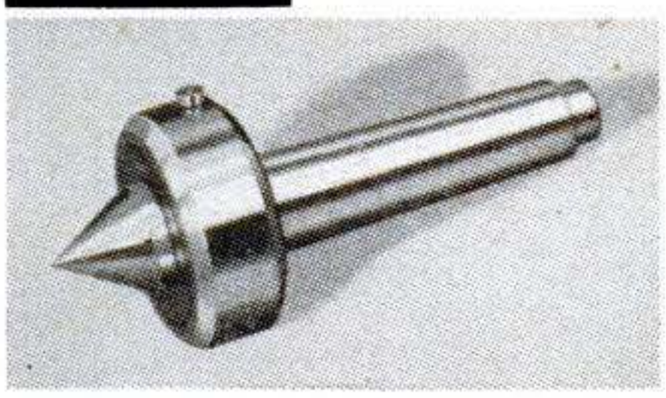

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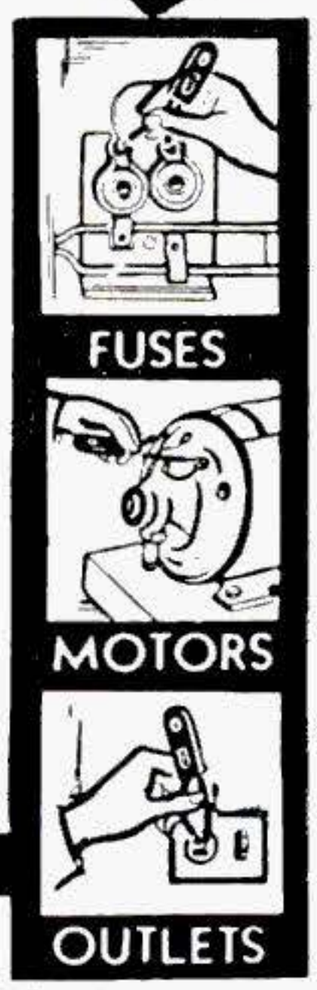

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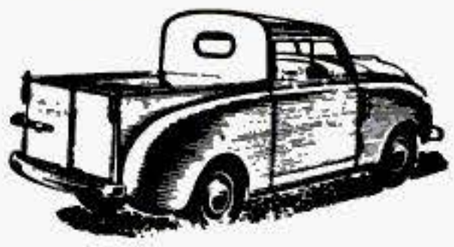

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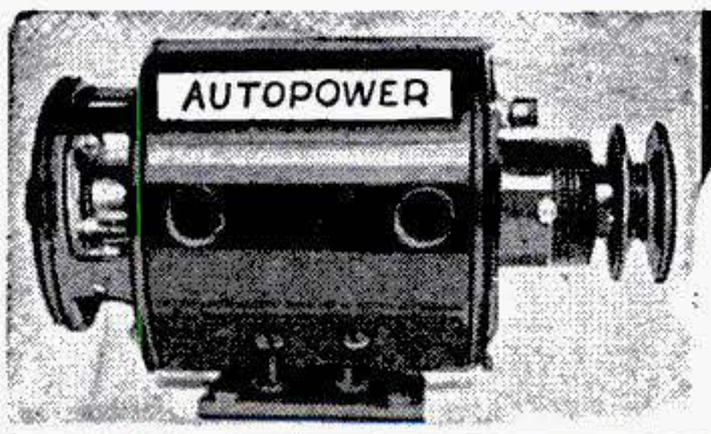

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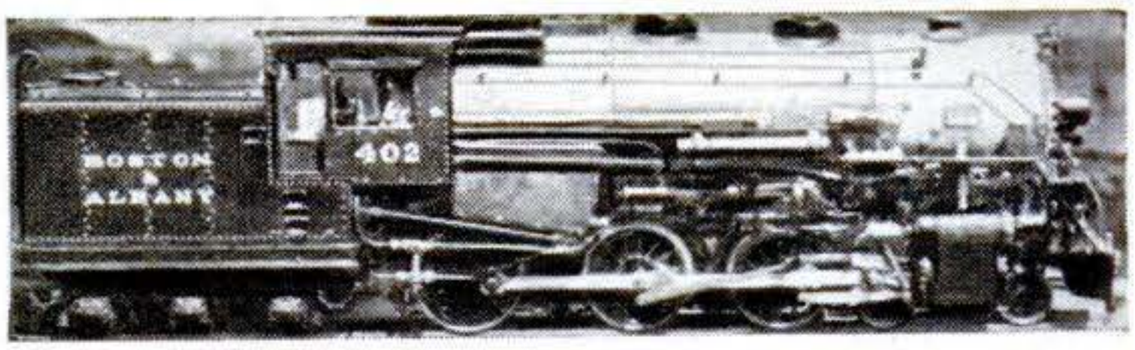

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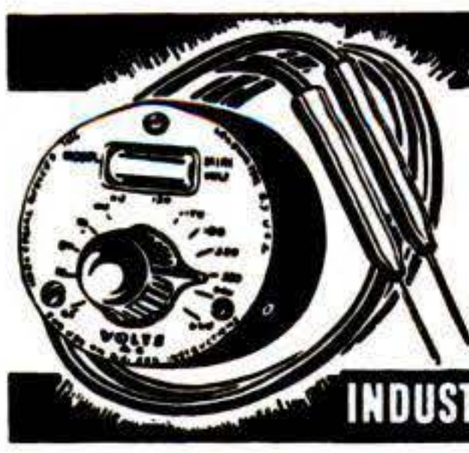

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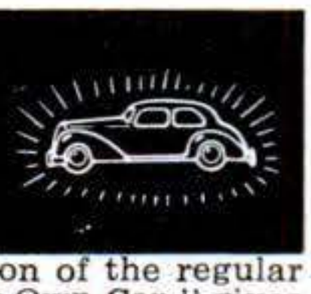

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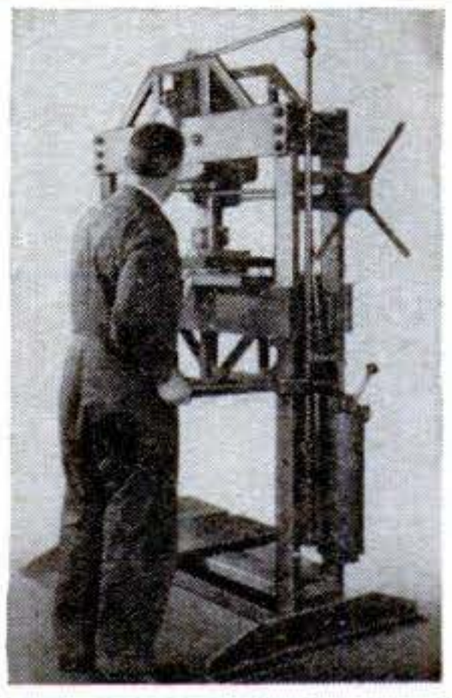

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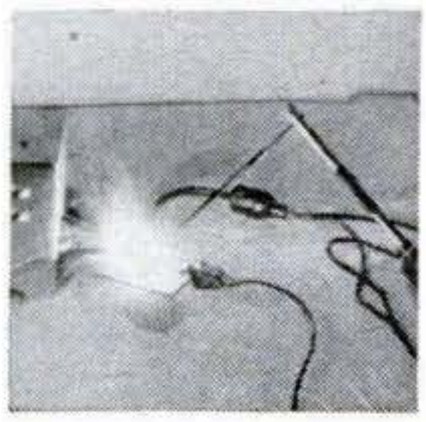

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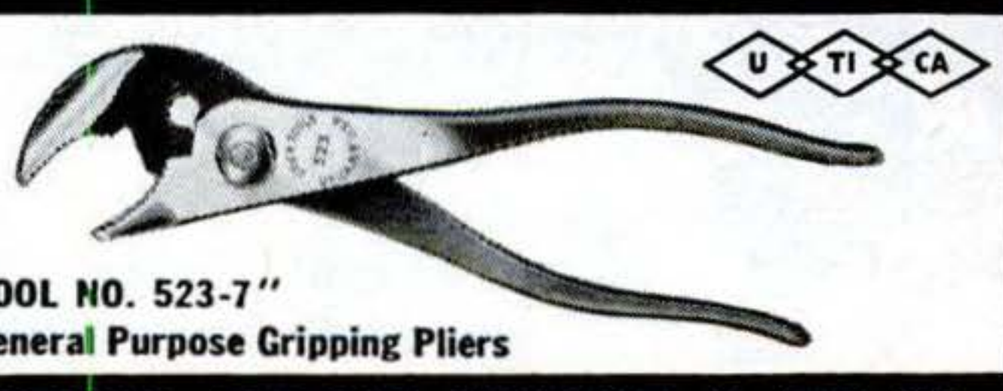

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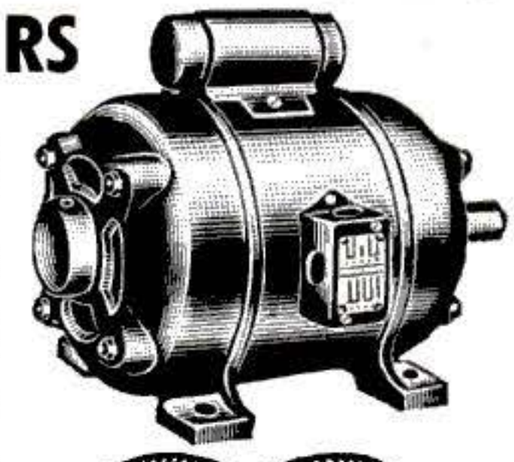

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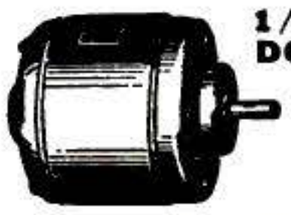

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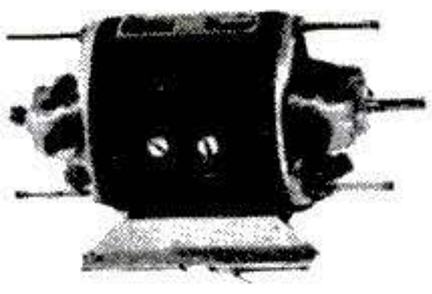

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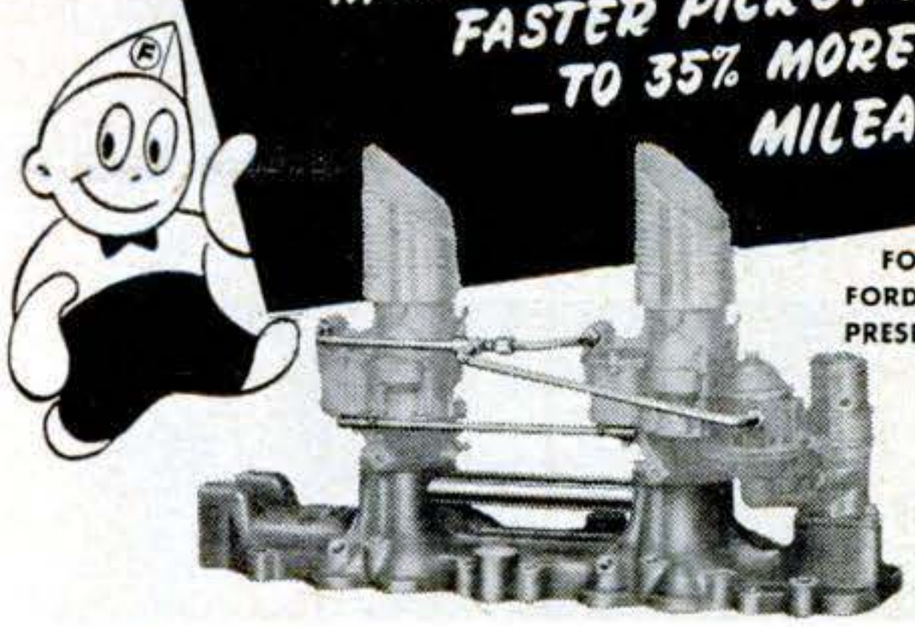

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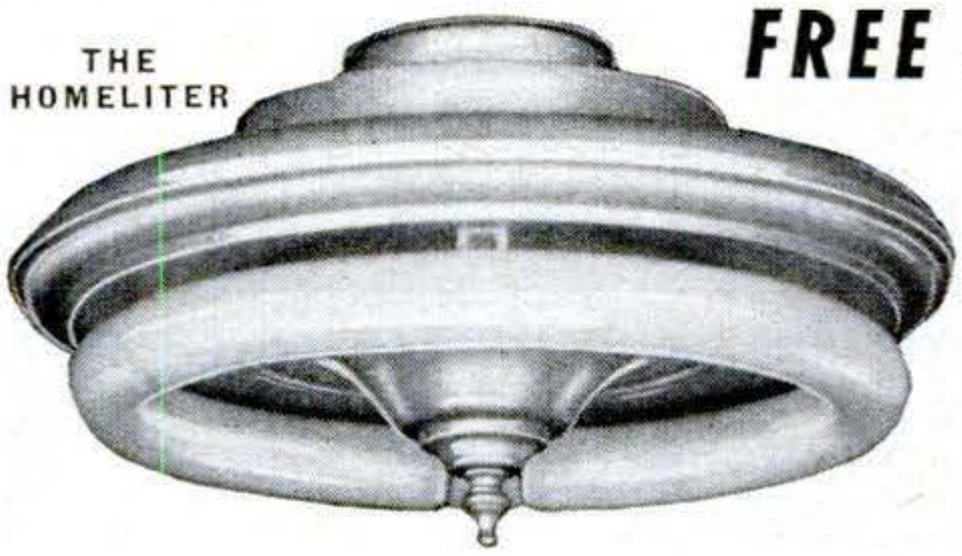

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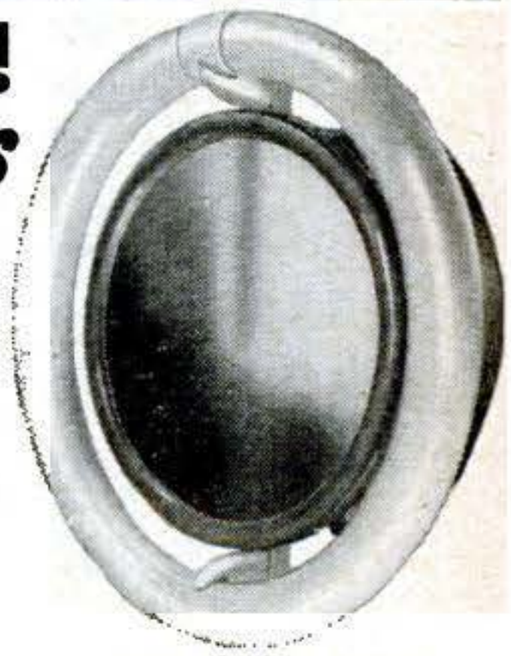

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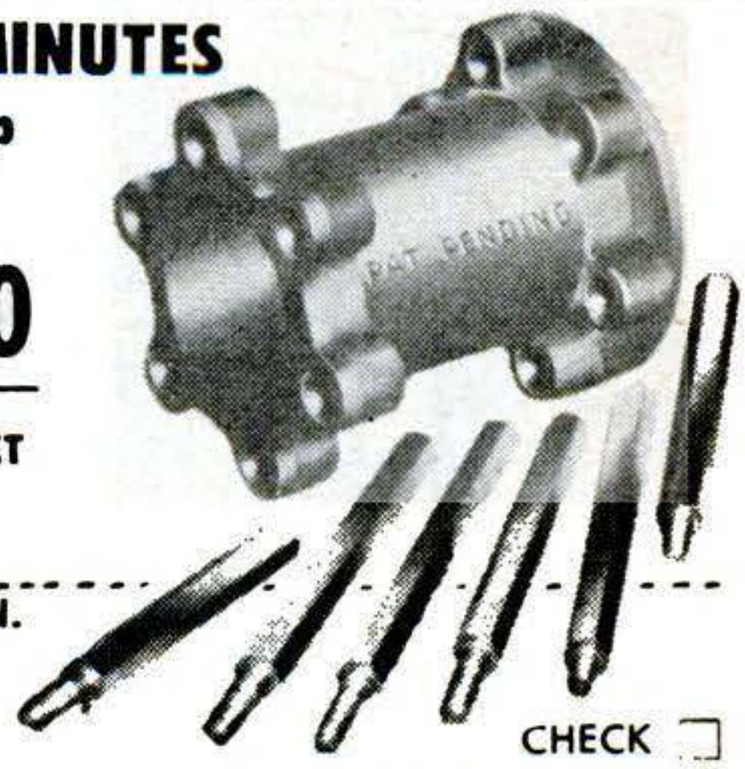

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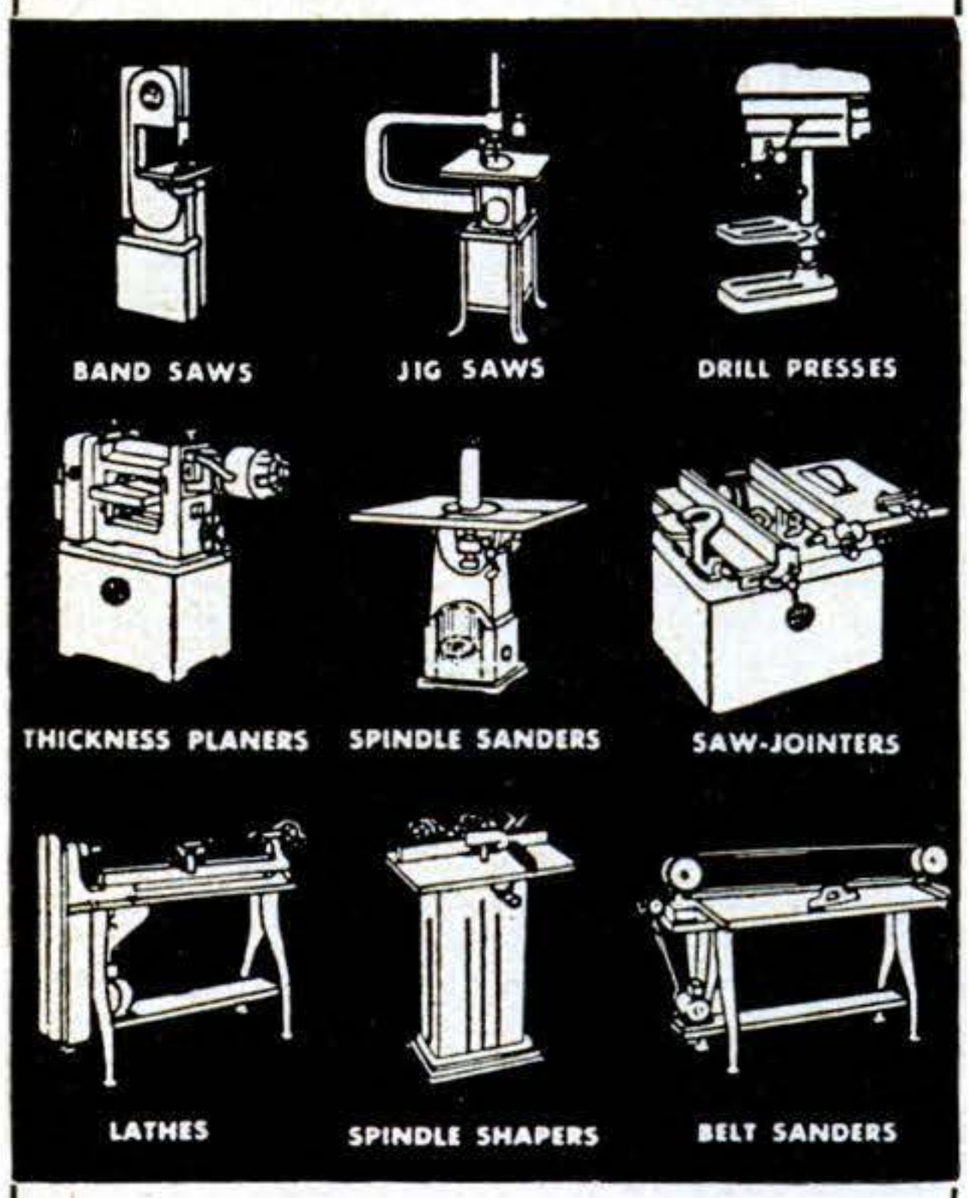

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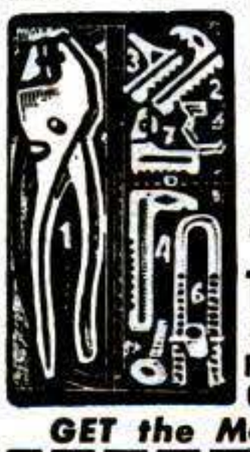

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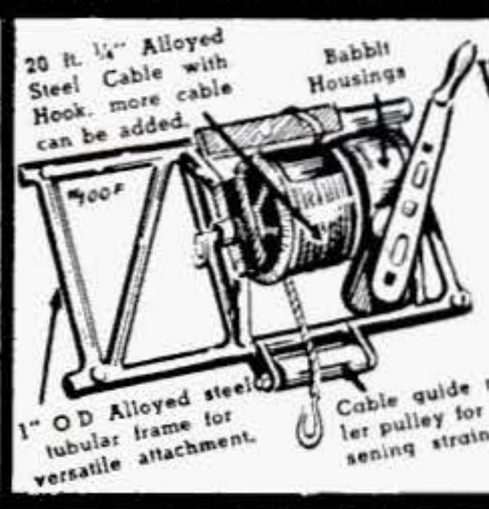

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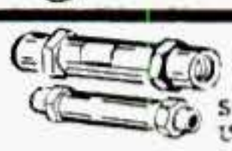
Pistol & Gooseneck Type
101 Uses, Chipping, Riveting, Hammering, Breaking cement and auto body work.
Chicago Pneumatic, Cleco, Ingersoll Rand Makes.
E3, E2, 3X, 2X, OY
$55 Value $8.95
PNEUMATIC ALLIGATOR SQUEEZER
$80 Value $15.95

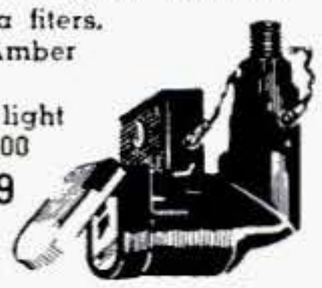
CHECK VALVES



METAL SEATS
Standard Pipe Size 1/2" or 1/4"
Usable with Air, Fuel, or Oil
Can withstand back up pressure from 50 P. S. I. to 2000 P. S. I. #CVA 1/4" PIPE $1.00 ea.
#CVB — 1/2" PIPE $1.25 ea.

Here's a Real "Lite Special"

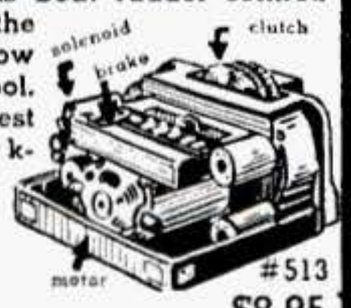
FARM, RANCH MOTORIST, TRUCK, HUNT ETC. U. S. NAVY AIRFORCE NEW GRIMES PORTABLE PISTOL GRIP, SEALED BEAM 12v, 24v with three extra filters. Red, Green, & Amber Spot, Search, Spot or Emgcy. light Govt. Cost $35.00 our price $3.49



AIRFORCE GUNSIGHT #102 $1.95
#102 Contains triple lens. #103A with N6A non glare variable density lens $2.35. Lenses in these sights are worth many times the entire cost of these items.

Electric GYRO PILOT Assembly Part

2 solenoids for reverse and forward motor control. 2 solenoids throw clutch to engage drive. With brake assembly. Can be used as boat rudder control, converted for lathe tapping and slow speed motor tool. Wt. 29 lbs. Finest precision workmanship.
Cost Gov't. Thousands!



#513
Your Cost $8.95

AIR DRILLS

CLECO ARO INGERSOL-RAND CHICAGO PNEUMATIC
1/4" JCB Chuck

Straight $12.95
Angle Drill $15.00

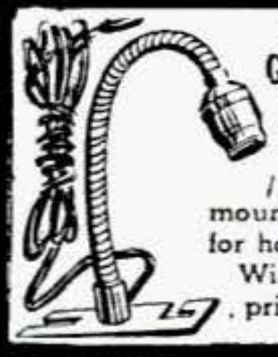
NEW PULMASON DUST RESPIRATORS

Ideal for use where foreign materials foul air. Paint Spraying, Grinding, Dusting Sanding etc. $1.19 ea.

NEW AMPLIDYNE MOTOR-GENERATOR

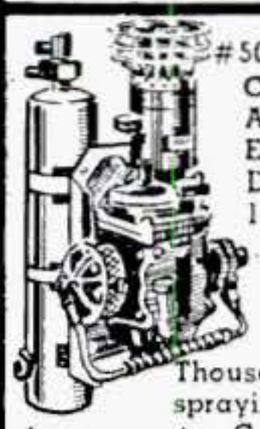
#511
With 24 volt current, it gives 60 volt output. This unit has been adapted to independent and rural lighting power.
Welding and many other uses. Weight 29 lbs.
Gov't. Cost Approximately $237.00!
A Steal at $8.95

NEW FLEXIBLE GOOSENECK LAMP



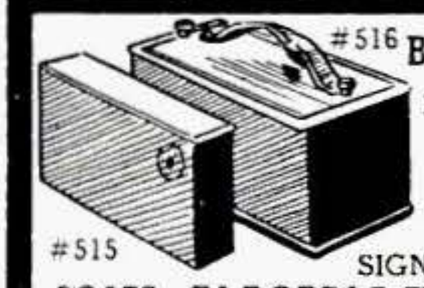
110 V. A. C. 13 ft. wire with socket, switch and plug. In mounting bracket suitable for home or workshop.
Wire alone worth our price of 99c each.

#506 COMPRESSOR



Complete With Tank And Fittings. General Electric. 2 stage AC-DC. Rated pressure 1000 lbs. per sq. in., with 1/3 H. P. 27 volt. 7 AMP series wound motor, equipped with fan for cooling.
Thousands now in use for spraying, inflating, laboratory use, etc. Can be adapted to 110 volt A. C. with transformers or 4 1000 heating elements. A tremendous value at approx. 5% of orig. cost Only $17.95

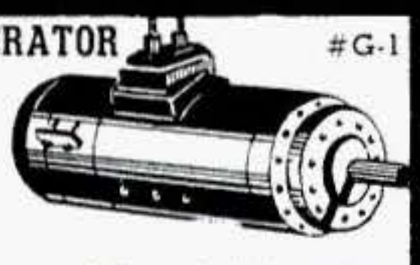
#516 BATTERIES



#515
NEW! FULL STRENGTH FOR PORTABLE RADIOS, SIGNAL LAMPS, BOATS, ELECTRIC TRAINS, ETC.
#516 9 Volt 8 1/2 x 6 x 4 in. ..... 3 run
24 or 27 Volt motor 79c
These batteries are especially suited to portable radios.
#517 67 1/2 & 1 1/2 Volt Battery 69c
#515 90 & 1 1/2 Volt 69c

DC GENERATOR #G-1

140 AMP Direct Current



Generator, especially suited for adaptation to homemade welding unit.
A fast moving item at $15.95

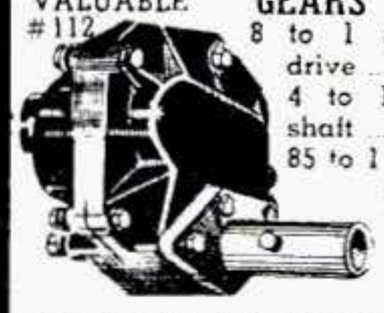
NEW PRESSURE TANKS

Stainless steel - Shatter proof. Rustless. 10,000 available in 3 different sizes. 1001 uses.
G-1 12 1/2 x 24 inches - 2100 Cu. in. capacity 29 cu. ft. $4.75
D-2 6 1/2 x 24 in. - 500 Cu. In. capacity - 7 cu. ft. $2.25
F-2 8 x 45 in. - 1000 Cu. In. capacity - 14 cu. ft. $3.95
Perfect portable air tank to carry in car or trailer. Ideal for painting cooking, spraying, ocean buoys

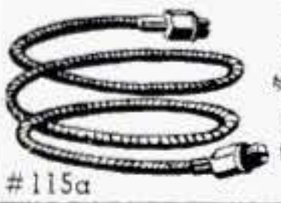
New Electric Motors

1/6 H. P., 24 volt. D. C. series wound motor.
#501 1/6 h. p. 24 V Series Wound New $3.95
#502-2 H.P. 24 V D. C. motor used $8.95

VALUABLE GEARS BARGAINS!

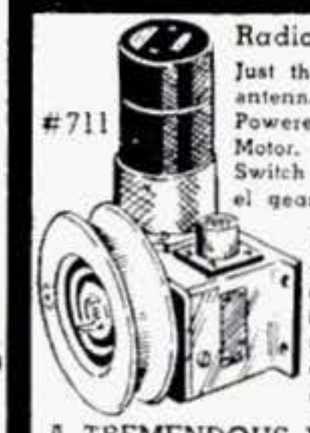


#112
8 to 1 ratio, spindle drive ..... #110 $2.98
4 to 1 with screw shaft ..... #111 $4.98
85 to 1 (can be used for radio, antennae, etc.) #112 $3.95
2 to 1 ratio 90° right angle #113 10 tooth bevel steel boxed gear $4.95
113a 6 to 1 ratio 90° right angle $4.95
Flexible Gear Shafts With End Drives
115 ——— 30" 69c ea.
115a ——— 60" 99c ea.
Radio tuning shafts that can be used as flex gear drives $115a 12 ft- 1/2" nut --15 tooth internal spline $1.95 ea.



#115a
$115b 25 ft- 1/2" nut 12 tooth with internal spline $3.95

Radio ANTENNA Reel



#711
Just the thing for tuning beam antenna
Powered by 1/8 h. p. 24v G. E. Motor. Removable 6" Reel-limit Switch - Cam Worm gears, Bevel gear, Solonoid clutch.
Motor engaged to gear reduction only when electrical contact made. Operates in either direction. Ideal for auxiliary power take-off, opening and closing doors, etc.
A TREMENDOUS VALUE $4.95

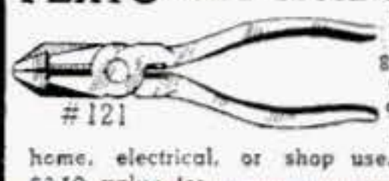
OUR PALLEY SPECIAL ELECTRIC SOLDERING IRON

#198
110 Volt A. C. "SOLDER MASTER"
$8.50 Value $2.95 200 Watts

FIRE EXTINGUISHER

#601
Kiddie Lux CO2 Type
Built to Gov't. Spec. 4 lb. Trig con. with horn, fully Recharged.
$30.00 value #601 $10.75
2 LB. CO2 TYPE
$22.50 value #602 $8.75
10 lb. Chgd. CO2 with Horn
$60.00 value #603 $24.50
15 lb. Chgd. CO2 with horn.
$80.00 Value #605 $27.50
NEVER AGAIN A BUY LIKE THIS!
indispensable for small or large planes, trucks, auto, home, factories.

PEXTO SIDE CUTTING PLIERS



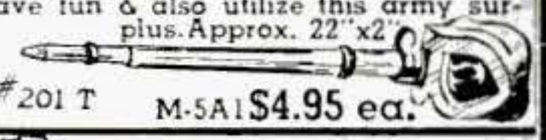
#121
Beveled head, lap joint. Size 8-500. Cuts wire, solid grip, alloyed steel. Ideal for home, electrical, or shop use. A $3.50 value for $1.95

CLAMPS

#121
Adel Aluminum, rubber lined. Mixed. #121 4 dozen 89c
Aero-Seal. Rust Resistant. Slotted with screw gear top. 1/2" to 3".
#120 Regular 27c now 10c

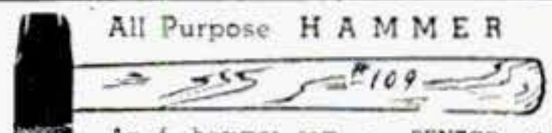
Tank Telescope 3 Power

Have fun & also utilize this army surplus. Approx. 22"x2"



#201 T M-5A1 $4.95 ea.

All Purpose HAMMER



Ax & hammer combination for wood & metal work. 3 1/2 lbs. 14 1/2" hardwood handle, hard steel cutting edge. 69c

Compound Action METAL SNIPS

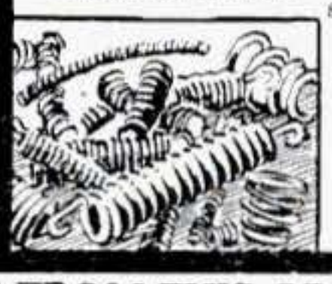
Hard steel blades. Expansion spring. Locking device.
Right Hand and Left Hand New $2.59

HOBBYISTS!

An Unequalled Value!
GADGET MIX
Rivets, spacers, Clamps, bolts, nuts, Radio parts, gears, etc.

#106
A gold mine ..... 5 lbs $1.19

SPRING MIX



Torsion, compression and tension springs. Assorted sizes. #206
2 lbs. 89c
A treasure shelf for emergencies!

PERISCOPE M3 2 Power

with small 3" telescope inside
$2.95 ea. #201 P
Lenses in both Scopes worth more

AIRCRAFT CABLE

Alloyed steel, rust resistant, 3/16" diam., 21 ft. long, with turnbuckle ends 99c each
ON REELS 1/8", in any length 4c per ft.
3/16", in any length 5c per ft.

BEARING MIX

Needle, ball and roller bearings in excellent assortment. Sizes from 1/2" to 2".
#170 Introducing this treasure shell assortment of 15 Bearings at $2.95

RUBBER GOODS

NEOPRENE SHEET RUBBER

	Thickness	approx. Width		Price per rang. yd.
#323	.015"	1/64	36"	.60
#325	.020"	1/64	36"	.75
#326	.037"	1/32	36"	1.25
#327	.064"	1/16	36"	1.75
#328	.175"	3/16	42"	6.00

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THE Warren DADO SAWING WASHERS!

Here is the answer to a woodworker's prayer! With the help of these 4 precision washers, your circular saw becomes the most versatile tool you own! Cut all of the notches and grooves illustrated — efficiently, accurately, and inexpensively No disassembly of your set-up—just a simple 15 second adjustment and you're ready to go! The washers are graduated in 32nds, and numbered to cut the width groove desired.

The WARREN Dado Sawing Washers come to you postpaid, complete with illustrated instruction sheet for mounting the washers on your arbor. Once there, they remain — quickly and easily adjusted to cut the groove desired, or for straight cuts. This fine set of precision-engineered washers will be shipped to you immediately upon receipt of your check or money order. We are sure that you will want yours as quickly as possible ! ! !

Order by arbor size
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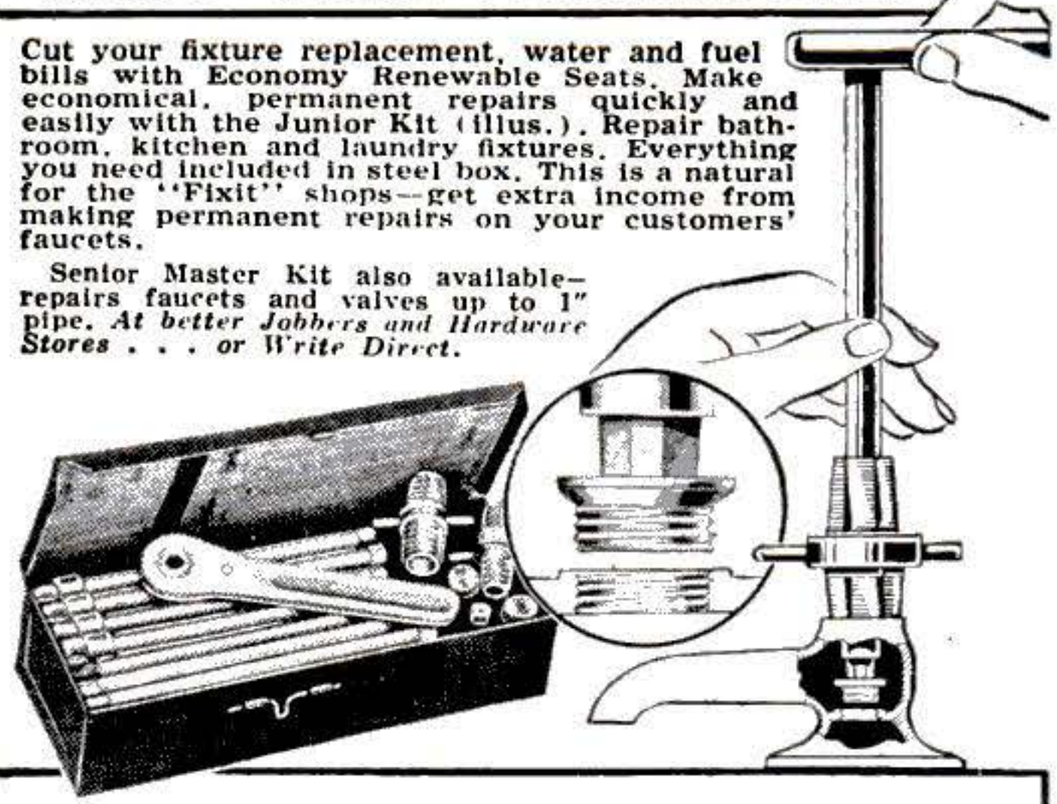
POST OFFICE BOX 98 • NORTH END STATION
DETROIT • MICHIGAN

STOPS LEAKS *PERMANENTLY*

Cut your fixture replacement, water and fuel bills with Economy Renewable Seats. Make economical, permanent repairs quickly and easily with the Junior Kit (illus.). Repair bathroom, kitchen and laundry fixtures. Everything you need included in steel box. This is a natural for the "Fixit" shops—get extra income from making permanent repairs on your customers' faucets.

Senior Master Kit also available—repairs faucets and valves up to 1" pipe. *At better Jobbers and Hardware Stores . . . or Write Direct.*



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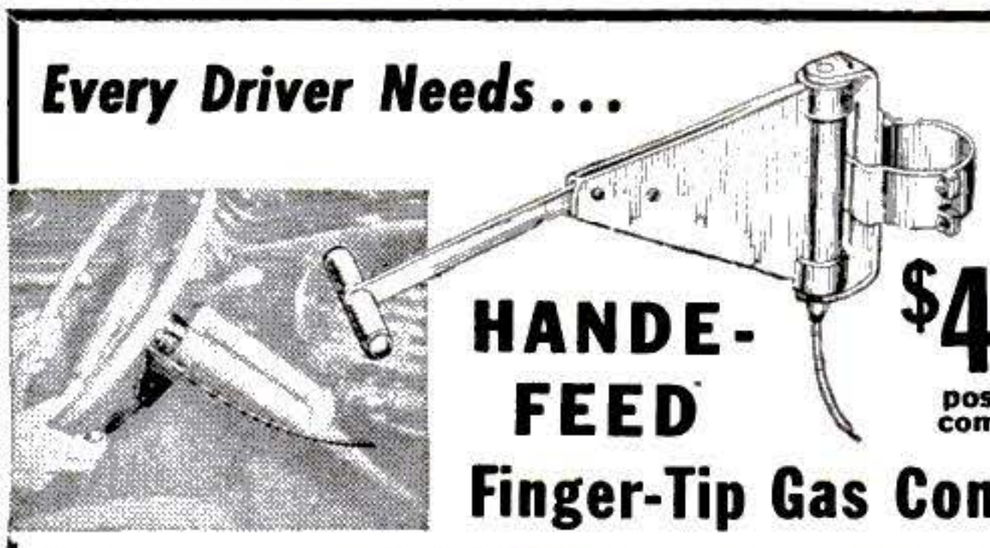
Every Driver Needs . . .



HANDE-FEED
Finger-Tip Gas Control

only **$4.95** postpaid complete

MINIMIZE DRIVING FATIGUE! . . . install HANDE-FEED on your car and DRIVE RELAXED! Installed in about 15 minutes. Fits steering post of most cars. Connects directly to carburetor. RELIEVES AND RELAXES THE FOOT. Minimizes back-roll on up-hill starts. Simply lift lever to increase engine speed, when released engine idles. Pivots for use with right or left hand. Does not interfere with gear shift or steering. All chrome finish. Complete instructions with every unit. $4.95 postpaid. Send check or money order.

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IGNITION protection from shorting out due to rain, sleet, snow, excessive humidity, condensation and radiator overflow. Simple, self-application **SHORTSTOP** protects spark plugs, ignition wires, spark coil, distributor cap and base, generator, battery cables and terminals. Gratifying results on inboard-outboard motors, airplane engines, tractors, diesel equipment, motorcycles and scooters, model airplanes and household motors. Tested by leading electrical testing laboratories. Send $1.00 postpaid today for generous four ounce bottle **SHORTSTOP** giving protection coverage minimum of one year.

CARDINAL CHEMICAL COMPANY, Hawthorne, New Jersey

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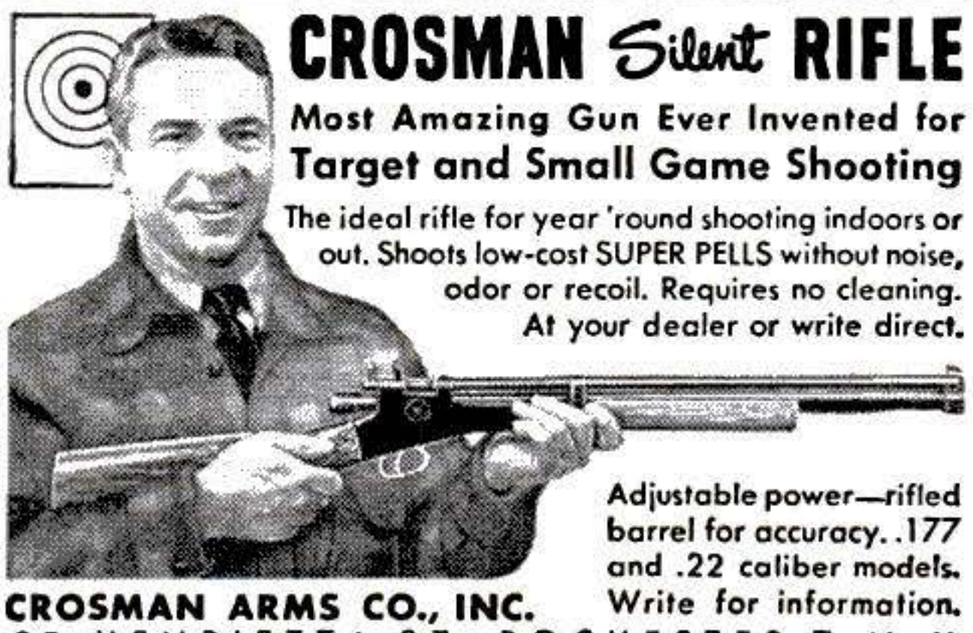
CROSMAN *Silent* RIFLE

Most Amazing Gun Ever Invented for Target and Small Game Shooting

The ideal rifle for year 'round shooting indoors or out. Shoots low-cost SUPER PELLS without noise, odor or recoil. Requires no cleaning. At your dealer or write direct.



Adjustable power—rifled barrel for accuracy. .177 and .22 caliber models. Write for information.

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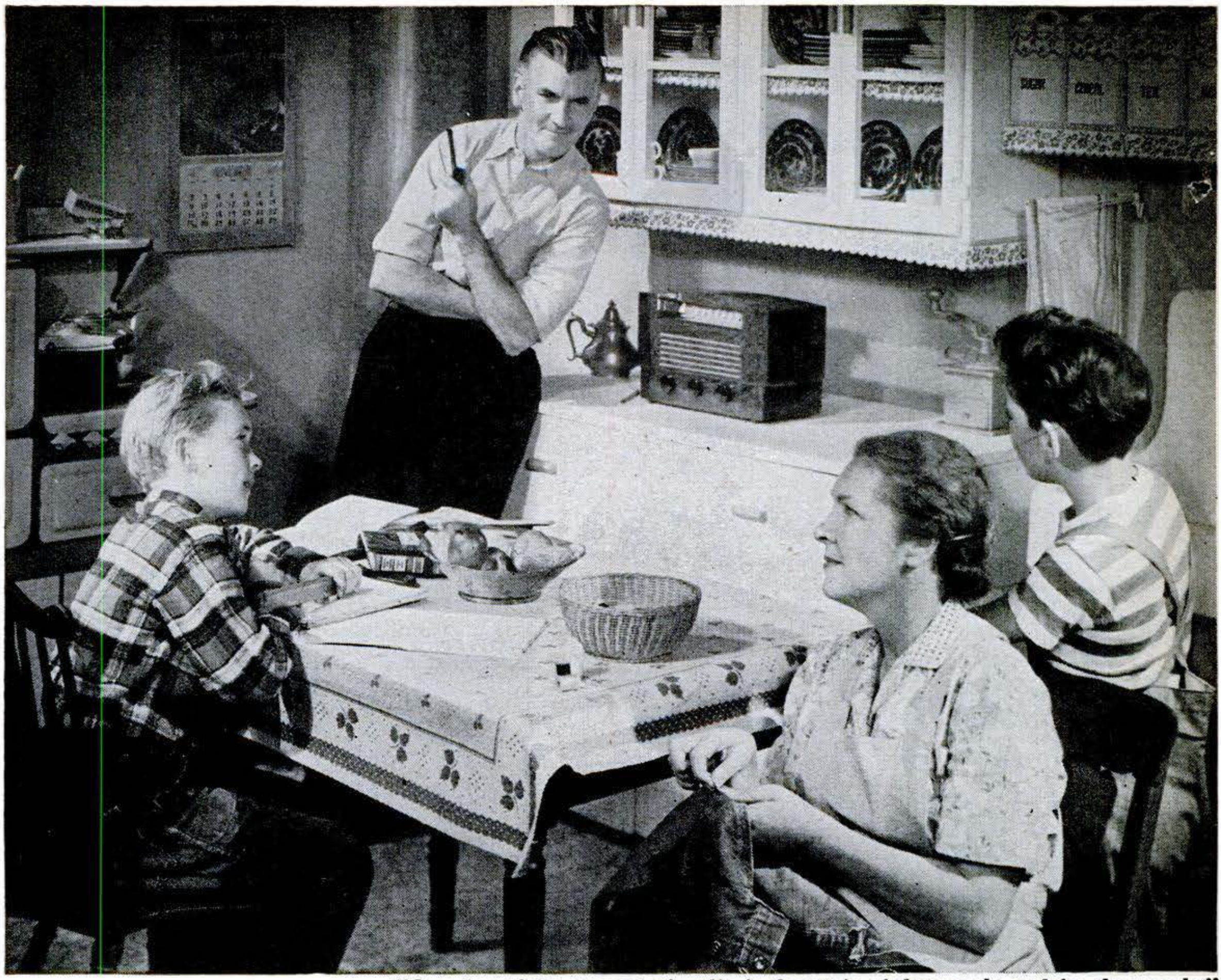

"Our American concept of radio is that it is of the people and for the people."

Freedom to LISTEN – Freedom to LOOK

As the world grows smaller, the question of international communications and world understanding grows larger. The most important phase of this problem is *Freedom to Listen* and *Freedom to Look*—for all peoples of the world.

Radio, by its very nature, is a medium of mass communication; it is a carrier of intelligence. It delivers ideas with an impact that is powerful . . . Its essence is freedom —liberty of thought and of speech.

Radio should make a prisoner of no man and it should make no man its slave. No one should be forced to listen and no one compelled to refrain from listening. Always and everywhere, it should be the prerogative of every listener to turn his receiver on or off, of his own free will.

The principle of *Freedom to Listen* should be established for all peoples without restriction or fear. This is as important as *Freedom of Speech* and *Freedom of the Press.*

Television is on the way and moving steadily forward. Television fires the imagination, and the day is foreseen when we shall look around the earth from city to city, and nation to nation, as easily as we now listen to global broadcasts. Therefore, *Freedom to Look* is as important as *Freedom to Listen*, for the combination of these will be the radio of the future.

The "Voice of Peace" must speak around this planet and be heard by all people everywhere, no matter what their race, or creed, or political philosophies.*

David Sarnoff

President and Chairman of the Board,
Radio Corporation of America.

**Excerpts from an address before the U. S. National Commission for UNESCO.*

RADIO CORPORATION of AMERICA

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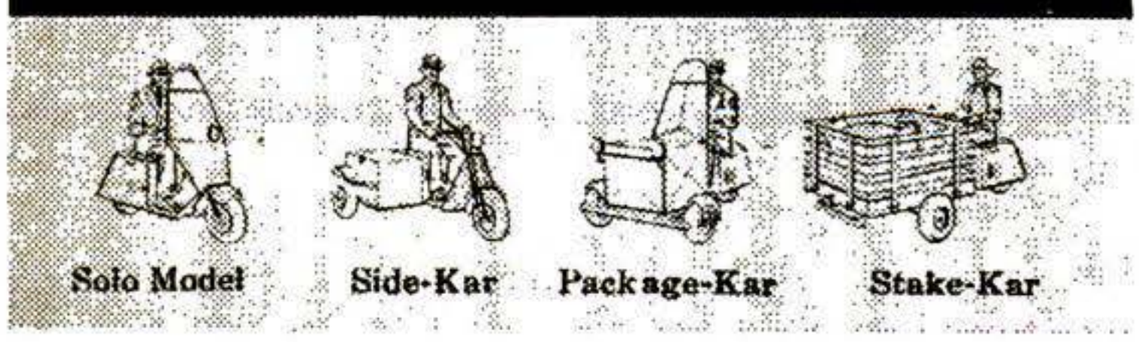
● Write for Free Folders, name of your nearest dealer and details of new TIME PAYMENT PLAN.

FREE

CUSHMAN MOTORWORKS, Inc.
Dept. S-100 Lincoln, Nebr.

4 GREAT MODELS TO CHOOSE FROM!



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FREE FROM OUTSIDE INTERFERENCE

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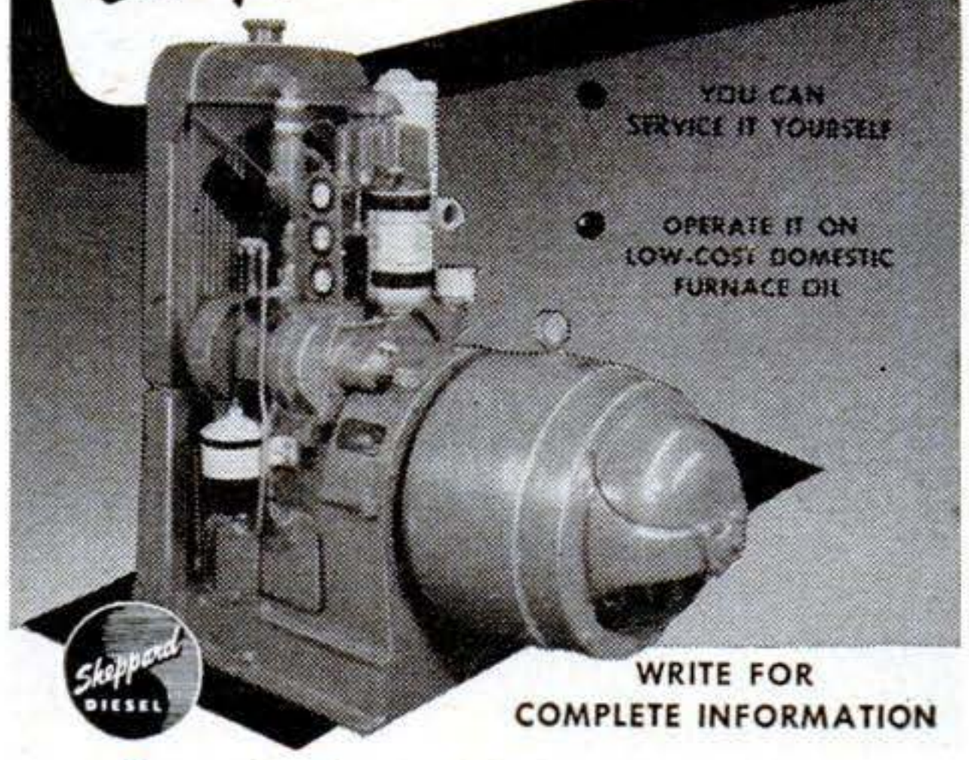
Sheppard's the Diesel



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Power Units . . . 3¾ to 56 continuous H. P.
Marine Engines . . . 3¾ to 62 continuous H. P.

R. H. SHEPPARD COMPANY, INC., 68, Middle St., Hanover, Pa.

POCKET OR PURSE SIZE RADIO!

SMALL AS A PACKAGE OF CIGARETTES Wt. only 4 oz.—**BEAUTIFULLY** molded silver black case. **NO TUBES—BATTERIES OR ELECTRIC "PLUG-INS" NEEDED!** Uses **NEW Type** fixed power crystal diode. ONE YEAR SERVICE GUARANTEE.

GUARANTEED TO WORK on local stations if used as directed. **Listen at home, in cabins, in bed, on farms, hotels, offices—most anywhere.** L. S. of Texas says "It's Wonderful".

SEND ONLY $1.00 (bill, money order, check) and pay postman $2.99 plus C.O.D. fees on arrival or send ONLY $3.99 for postpaid delivery. **Complete—Ready to play! Marvelous gift for children or grownups; Bargain priced! Order your Pakette Radio now!** (Foreign $5.00 U. S. Cash).

PAKETTE RADIO COMPANY, INC., Dept PPS-1, Kearney, Nebr.

WITH MOLLY YOU CAN FASTEN ANYTHING and do it quickly, neatly and safely. MOLLY will hold fixtures securely to floors, ceilings or any hollow wall construction . . . Simple to install, all you need is a screw driver. Sold by leading hardware stores everywhere.

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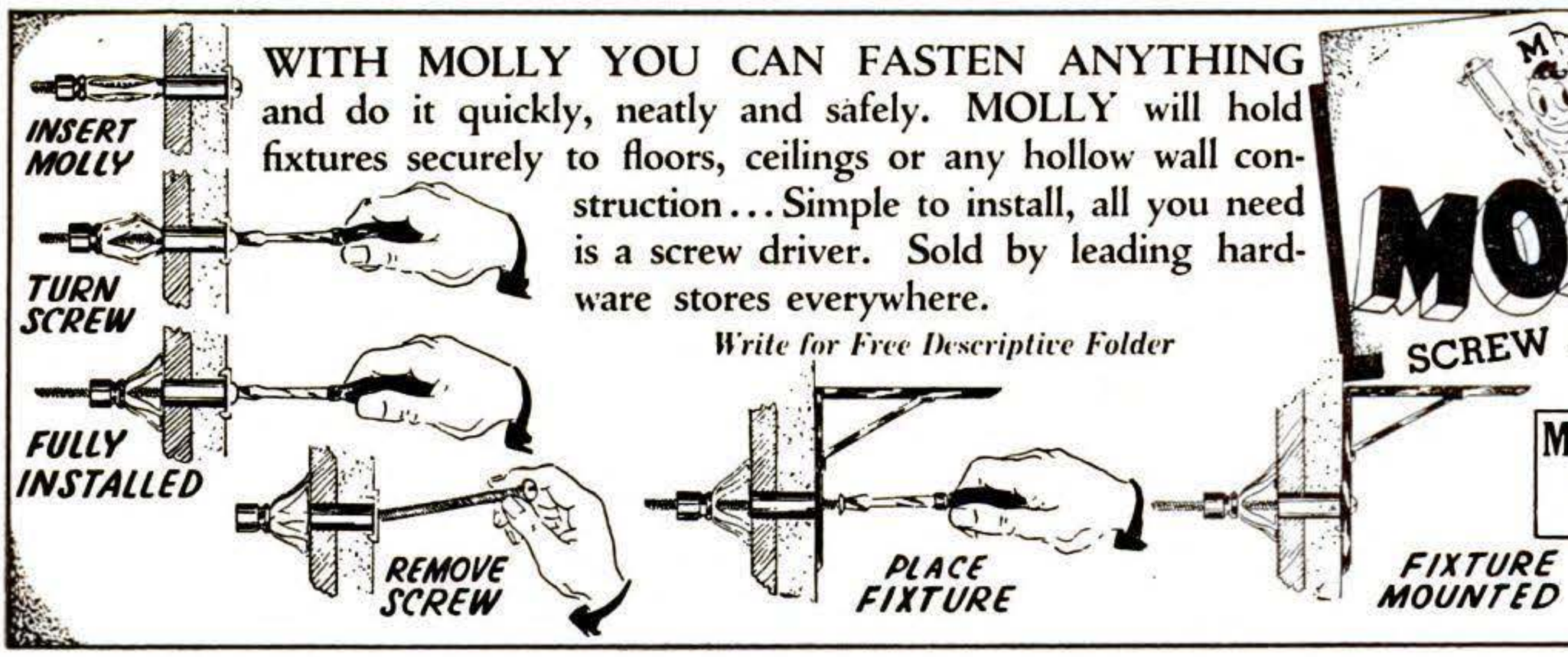

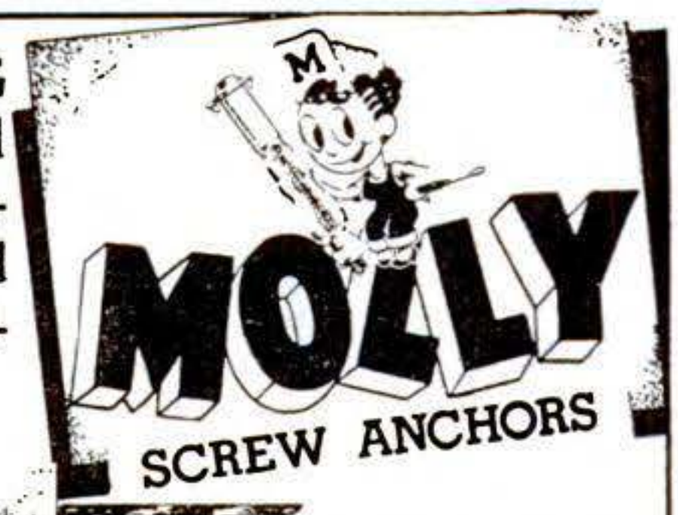

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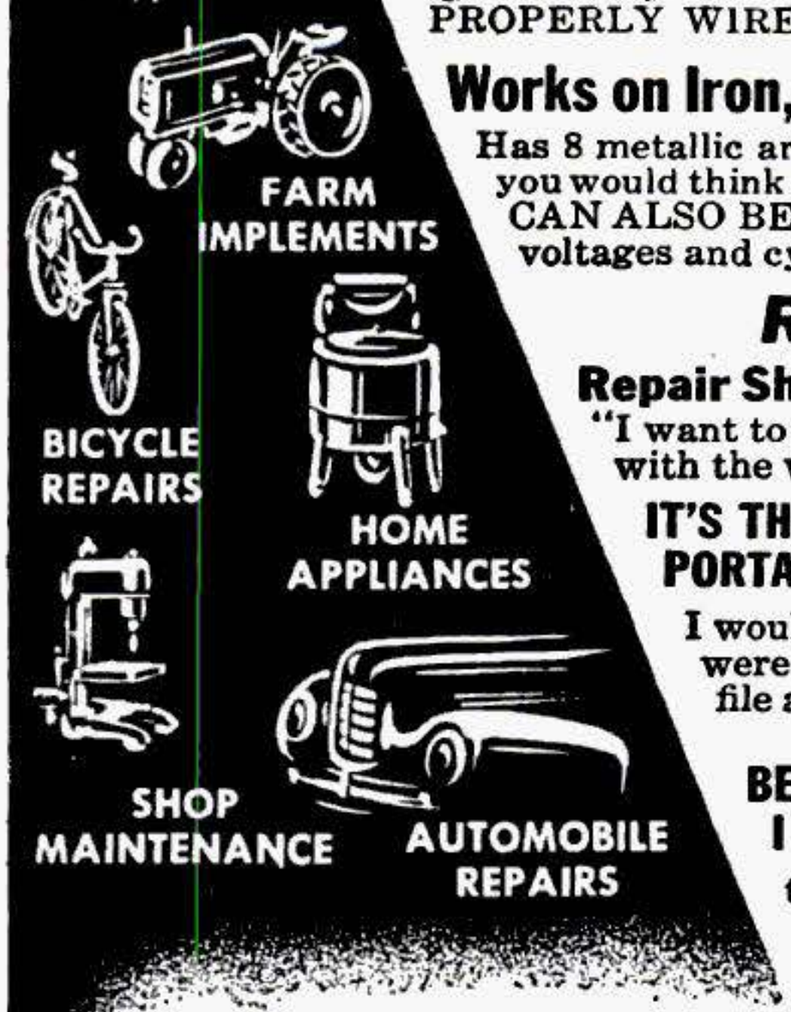
Saves You Valuable Time and Money!

This portable, industrial transformer type Welder easily carried right to the job can be OPERATED FROM ANY CONVENIENT PROPERLY WIRED 110 VOLT 60 CYCLE LINE.

Works on Iron, Steel, Brass, Bronze and Other Metals

Has 8 metallic arc and carbon arc welding heat stages. Does work you would think only possible with a larger, more expensive machine. CAN ALSO BE SUPPLIED for 220 volt 60 cycle operation and other voltages and cycles at slight additional cost.



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Repair Shop Owner says "It will do more than you say"
"I want to say I operate a repair garage and am more than satisfied with the welder. It will do more than you say." *C. P., Butler, Ohio.*

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BETTER THAN I EXPECTED "I have done quite a little welding with my welder and will say it is better than I expected. The price, convenience and variety of work that can be done with the Dynamic are the attractive points." *W. R. P., Portland, Ore.*

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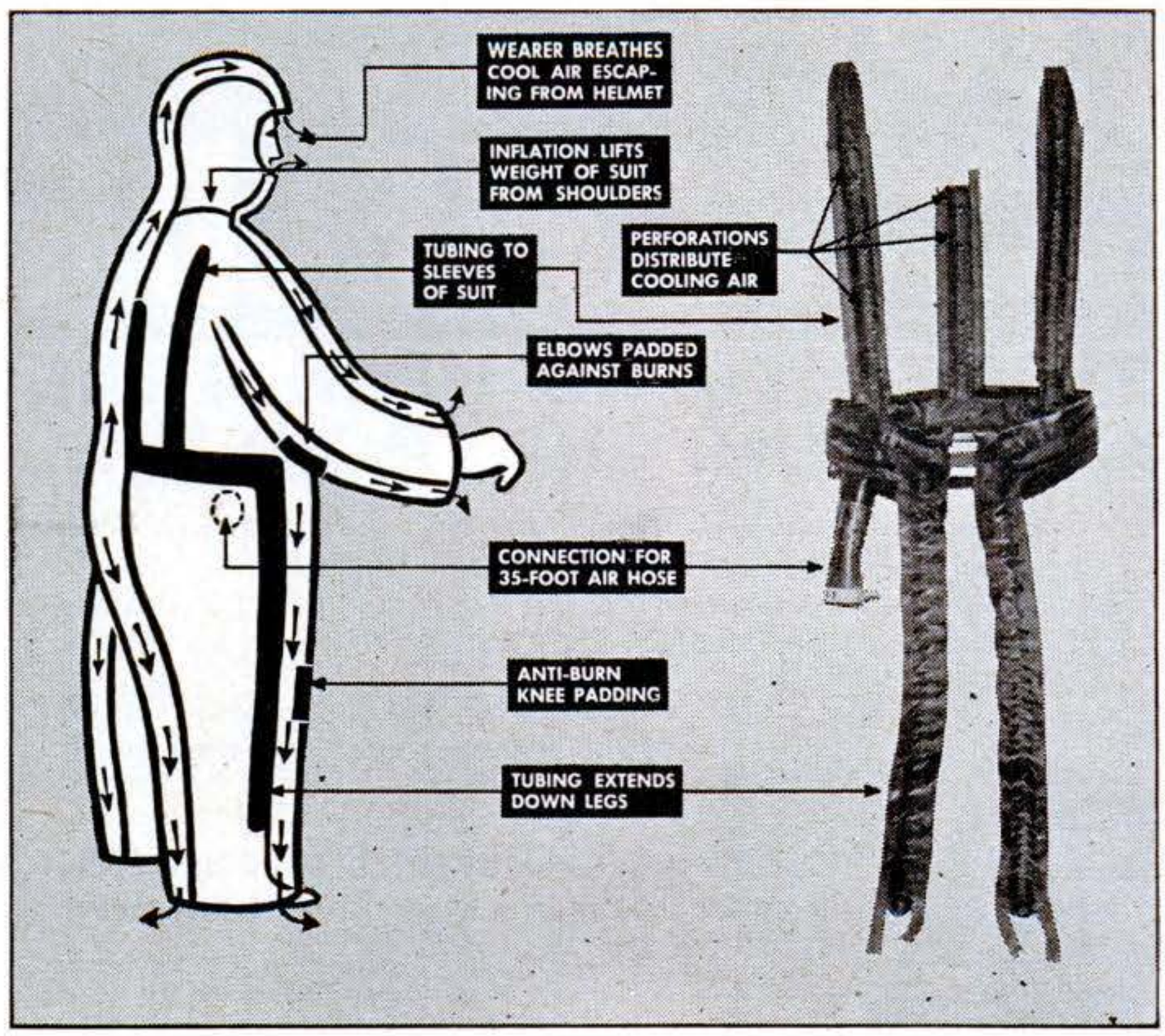
TO: Reader
FROM: Editor

What's Your Problem?



A MAN in the foundry business has written us for more information on the "hot suits" used in the Air Force's climatic hangar (PS, Sept. '47, p. 138). These are the work clothes with built-in air conditioning that keep humans from passing out when the big weather factory simulates the Sahara with a temperature of 165°. The man thought such suits would be sensibly stylish around foundries that put on a pretty good imitation of Hades every day.

Here is a reader who really knows how to read POPULAR SCIENCE. He goes beyond reading for enjoyment and reading for information. He also reads for ideas.

Ideas are our business. POPULAR SCIENCE is as full of ideas as a dictionary is full of words. Lots of these ideas are plainly labeled on the package:

Garden-Hose Syphon Empties Flooded Cellar.

Wrench Is Self-Ratcheting

Hollow Tiles Make Doorstep

Camera Viewfinder Marks Center

Smoke Meter Aids Fire Patrols

Now, all of these ideas are specific applications. Either you have some hollow tiles kicking around and you want to make a doorstep—or you don't.

But some of the best ideas are walking about in these pages in disguise. You have to know how to recognize them—and how to apply them, perhaps with a little different twist, to *your* problem.

Take those hollow tiles—maybe you don't need a doorstep, but how about using them for that terrace you're planning? That smoke meter, if you run a coal-burning power plant, might be rigged with mirrors to tell you when the smoke from your stack was getting too black.

Ideas are what you make them. A friend of mine, watching an asphalt road being laid, thought this kind of construction ought to be good for small swimming pools. Cheaper than concrete, easier to patch with a bucket of hot tar, and flexible enough to stand frost heaving it around. If it works, it will be a fine way to make water holes for cattle and fire-protection ponds for rural areas.

Yes, POPULAR SCIENCE has ideas in all sizes. But we don't always know they are there. After all, we aren't foundrymen—and it took a foundryman who recognized the shape of his own problems to recognize in a PS picture an idea that could be applied to his business.

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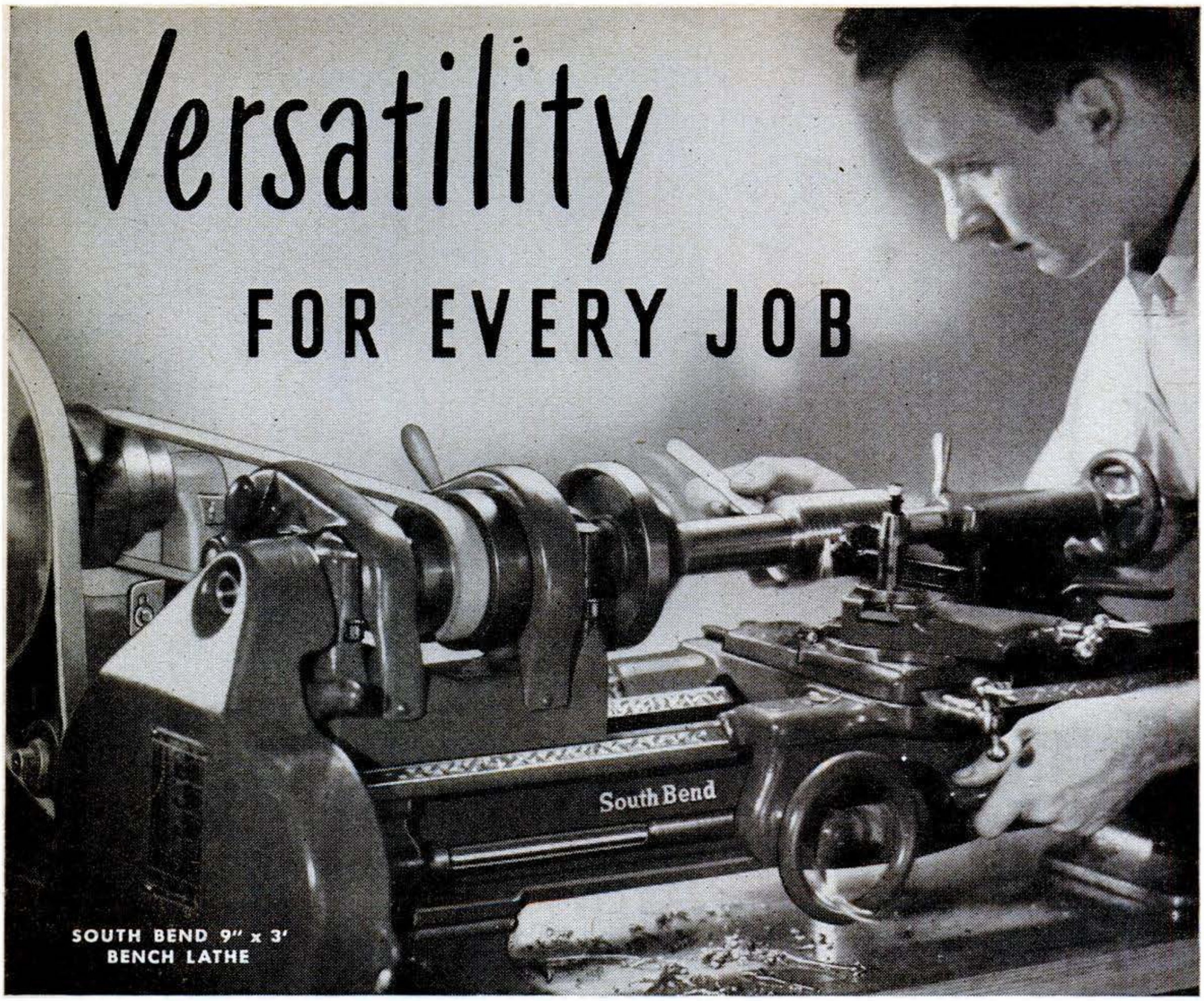

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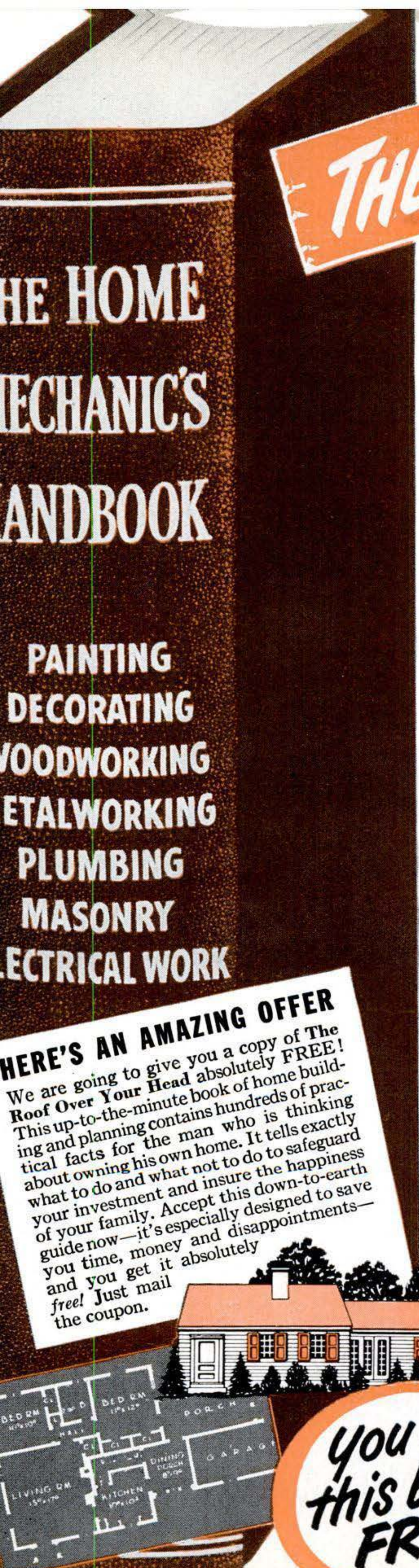

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